INHABITING THE INTERSTITIAL:
DESIGN EXPERIMENTS IN AVIARY ARCHITECTURE AND HABITAT CREATION

BY

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THESIS

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ABSTRACT

This thesis explores the potential of urban interstitial spaces in bird habitat creation. An interstitial space is the space in-between, underneath, beyond, enveloped, and outside our traditional concepts of habitat and urban space. It is the space between spaces, the space that eludes maps, an aggregate of remnants that collectively represent a habitat of the in-between. Similar to urban plants and animals, urban interstitial spaces are often overlooked, underappreciated, and marginalized, yet they represent an important element of the urban landscape. This thesis aims to redefine the notion of interstitial space and its role in urban ecology by exploring its potential as a habitat for birds and a site of architectural intervention. Although conventional approaches to the habitat design in cities emphasize the role of natural areas, parks and green roofs as the primary habitat, between these spaces is an interstitial space that may help to connect habitats and form intimate, visible, and thoughtful, human-bird relationships. This thesis proceeds with a series of mappings, ecological studies, and design prototypes for aviary architecture in downtown Chicago. Bird habitats will be introduced into urban interstices by identifying the unique requirements of habitats and the conditions of interstitial spaces and species.

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CHAPTER 1: INTRODUCTION

1.1 Background

In early cultures, animals were viewed as sacred. Human survival depended on the hunt, which required keen observation and understanding.[1] An intimate bond and respect developed, which is less likely today because most creatures that are not a part of the human plan are considered either a threat or a pest. Nowadays cities are mostly designed only for humans. Benefits for other species are largely ignored, which causes negative impacts on urban ecology and biodiversity. To address this problem, arbitrary boundaries established between species of wildlife by humans may be eradicated and altered through design interventions that commingle human and nonhuman species. Humans should view themselves as partners in an intimate and reciprocal relationship with other ecological forces.

The application of ecological principles to urban design must include a discussion of species diversity as an indicator of ecological health. Issues of species diversity in urban environments suggest that new forms of architecture and landscape may be conceptualized as habitats, which leads to design strategies for non-human species. Designed as a human habitat, the modern city may be understood as a monoculture that is shared in a very narrow spectrum of animal and plant species. However, urban animals often thrive within this monoculture. New architectural precedents, such as

[1] Fritz Haeg. *Animal Estates.* http://www.fritzhaeg.com/garden/initiatives/animalestates/main2.html

"animal estates"[2] and "animal architecture"[3] have established a framework for further inquiry into the nature of urban wildlife habitats.

Birds are an invaluable part of our shared heritage in cities, wilderness, and even in domestic settings. They are not only delightful to observe, classify, and photograph but also indicators of our natural and cultural health. The city harbors an impressive diversity of birds that are both residents and migrants. However, urbanization and humans' need for space are continually increasing, thus leaving little room for avian habitat.[4] Under a roof, you may find a swallow's mud nest attached; close to a green façade, you may find a small opening through which cardinals fly. Even on a street with heavy traffic, if you look overhead, you can see falcons perching on the ledges of buildings. Around the world, certain birds have made their homes in domestic settings that draw people's attention to come and visit, for example, the falcons in NYC, the crows of London tower, the parrots in San Francisco, etc. These interstitial spaces have great potential for the emergence of a new type of urban habitat that can thrive. Conventional approaches to the design of bird habitat in urban areas usually emphasize the role of natural reserves, parks, and green roofs as the major habitat, but between these spaces exists an interstitial space that may contribute to a bio-diverse view of urbanism. For example, Chicago is famous for its many parks and an ambitious green roof network, yet the space

[2] Fritz Haeg. *Animal Estates.* http://www.fritzhaeg.com/garden/initiatives/animalestates/main2.html
[3] Animal Architecture. http://www.animalarchitecture.org
[4] U.S. Fish and Wildlife Service. *Urban Conservation Treaty of Migratory Birds: Program Handbook.* U.S. Fish and Wildlife Service, 2001, 8.

between these two systems may contribute to a robust understanding of habitat beyond these dominant types.

Therefore, the purpose of this thesis is to explore the potential of interstitial or non-traditional spaces for the creation of bird habitat in downtown Chicago. Chicago has an interesting history of resident birds, the Monk Parakeet once lived in the city as an urban pet, colonizing electrical poles, and bringing curiosity to the cities' avian population. I hope to build upon this precedent ,and others, to introduce birds in new relationships with humans. The research process will consist of models, mappings, ecological studies, and design prototypes. Target species and their habitats will be become a part of our cities, river banks, neighborhoods, backyards, streets, bridges, parking lots, garages, and so on.

The thesis intends to eradicate the boundaries that have been established between humans and wildlife by highlighting the existence of an often-overlooked urban eco-system and fostering a visible, intimate, and thoughtful relationship between humans and birds.

1.2 Conceptual Framework

The research uses the setting of downtown Chicago to establish a hypothesis for the design of bird habitat at the interstice of conventional habitat types, such as green roofs

and parks. The premise is that small interventions made in the interstitial space can influence both ecological function and urban landscape. Traditional practices of bird habitat conservation have a tendency to focus on nature reserves and parks. However, every facet of the urban environment, from community gardens, to backyards, to parking lots holds another scale for creating or maintaining avian habitat. Thus, infiltrating the city's interstices could be an alternative method of addressing the absence of avian habitats.

To articulate the idea that the city and its spaces act as habitat and home to birds and suggest that birds take on meaningful roles in defining urban living specifically, the characteristics of five target species were studied and analyzed. Specific aviary architecture prototypes for each species were then suggested and built in a variety of selected interstitial environments in order to increase opportunities for and awareness of these avian citizens. Thus, a set of questions that challenge assumptions about how the city is built and used, and how birds may dwell among humans are established.

1.3 Overview of The Study

The study begins with the identification of urban interstitial spaces. According to the dictionary, literature and personal observations, speculative models and diagrams are produced in an effort to categorize and abstract the spatial topology. I have selected five birds with distinctive characteristics and habitation preferences to initiate this study,

though the methods presented here may be expanded to other species and cities. All of the species selected have at one time been found nesting in the Chicago downtown area. Therefore, their potential for introduction into urban interstices can be further investigated, based on preexisting relationships with the city and its human inhabitants.

Data for bird habitat locations and sites was provided by reliable online datasets based mostly on the databases of the Cornell Laboratory of Ornithology and the National Audubon Society., Information provided by these sources includes living range, identification, life history, habitat, food, and nesting behavior of the target species are described and presented visually. Storyboards, diagrams, and montage are the three types of visual representation used to gain a comprehensive understanding of the birds' characteristics. After the above analysis has been done, a design is proposed, which consists of five avian architecture prototypes. The next step is to integrate the prototypes into suitable urban interstitial environments. I selected twenty sites for the setting of the five prototypes based on the habitat suitability index HIS(Habitat Suitability Index) and the eBird database.[5]

The thesis aims to emphasize the whole research process through which the inquiry was initially developed and subsequently investigated. This process offers a possible design

[5] Ebird is a global tool that allows birders to record what they see in the field on a smartphone or tablet, and then send the data directly to the database. http://ebird.org/ebird/map/

approach of creating a new avian habitat system in the downtown area of Chicago, and it also serves as a replicable model for other areas in similar conditions.

CHAPTER 2: LITERATURE REVIEW

2.1 Value of Birds

Birds are a priceless part of our heritage. They are not only a delight to observe, classify, and photograph, and also contributes aesthetically, scientifically, economically and culturally to human life.[6] They have been an integral part of human existence since prehistorical times. For the majority of people, birds are often their most frequent connection to wildlife, and one they can enjoy on a daily basis. The movie "The Wild Parrots of Telegraph Hill" which was directed, produced, and edited by Judy Irving is a fascinating documentary film, telling a story about a homeless musician and his friendship with a flock of feral parrots. These parrots are not native birds, they all born in the wild and imported from South America. No one knows how they escaped captivity, found each other and started their flock. However, these delightful and intelligent birds have survived and thrived in urban settings. The unemployed musician names Mark Bittner used to live in a cabin close to the parrots in Telegraph Hill in San Francisco. He became curious about the parrots and found them beautiful and lovable. Then he began to feed and interact with them like a friend. It is quite impressive that the man illustrates he found the birds share many emotional similarities with humans, for example, they also have a sense of humor, they feel sad and they are curious about things. To some extend the only differences between humans and animals are just degrees of intellectual

[6] U.S. Fish and Wildlife Service. *Urban Conservation Treaty of Migratory Birds: Program Handbook.* U.S. Fish and Wildlife Service, 2001, 8.

capacity. This is a powerful example that makes many people become interested in the spiritual dimension of urban wild birds.[7]

Many ecological studies have noted that the survival and well-being of birds serve as indicators of the overall health of the ecosystem. Birds play a significant role in pollination and insect pest control; as such, they are crucial links in the food web. Some birds are considered keystone species because their presence in an ecosystem affects other species indirectly.

Birds are a common motif in ancient art, mythology, folklore, and popular fiction. In the article, "A Brief History of Birds on Buildings," Kelly Brenner discusses the folklore of several birds. The magpie is thought to bring good luck by landing on a roof or nesting under it. Storks have had a link with belief and folklore for a very long time. In European countries, they symbolize springtime and childbirth.[8] There is also an old superstition in Britain that "if the Tower of London ravens are lost or fly away, the crown will fall and Britain with it." The legend of the ravens in the Tower of London is so important to the British that today six permanent ravens are still kept in the tower at the expense of the

[7] "The Wild Parrots of Telegraph Hill," *Independent Lens*, 2007, accessed May 24. http://www.pbs.org/independentlens/wildparrots/film.html

[8] Kelly Brenner, "A Brief History of Birds on Buildings," *The Metropolitan Field Guide,* 2008, accessed December 20. http://www.metrofieldguide.com/a-brief-history-of-birds-on-buildings/.

government.[9]

The level of bird-related recreation is also a strong indicator of the value of birds to society. Nature-based recreation is the fastest growing segment of the tourism industry. For many people, birdsong enriches the outdoors, and bird watching is one of the fastest-growing recreational activities. For example, the ravens in the Tower of London are a popular tourist attraction. The Congress Avenue bridge in Austin is the home to the largest urban bat colony in North America. An estimated 100,000 people visit the bridge each year, generating ten million dollars in tourism revenue annually.[10] As stated in the program handbook of *Urban Conservation Treaty for Migration Birds*, "eighteen million adults take trips annually for the express purpose of watching birds. In fact, birding is growing faster than biking, pleasure walking, skiing, and golf among outdoor recreation activities."[11]

Today, birds are thought to be lovely and beneficial to many people. However, some birds are seen as pests although they pose no actual harm or threat to humans.[12] The

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[9] Jeffrey Vallance, "Myths of the Raven:The Myths And Meanings of The Tower of London Ravens." *Forteantimes* 11 2007. http://www.forteantimes.com/features/articles/879/myths_of_the_raven.html

[10] "Congress Avenue Bridge." Bat Conservation International, accessed February 16, 2012. http://www.batcon.org/index.php/get-involved/visit-a-bat-location/congress-avenue-bridge

[11] U.S. Fish and Wildlife Service. Urban Conservation Treaty of Migratory Birds, 2001, 8.

[12] Kelly Brenner, "A Breif History of Birds on Buildings."

ever-increasing human need for development results in the occupancy of more and more natural space. The habitable areas for birds are shrinking and becoming increasingly divided and isolated. Fortunately, many people recognize the benefit of birds and take steps to protect them. This is good for not only the birds but also for the quality of life of people living in and visiting the city.

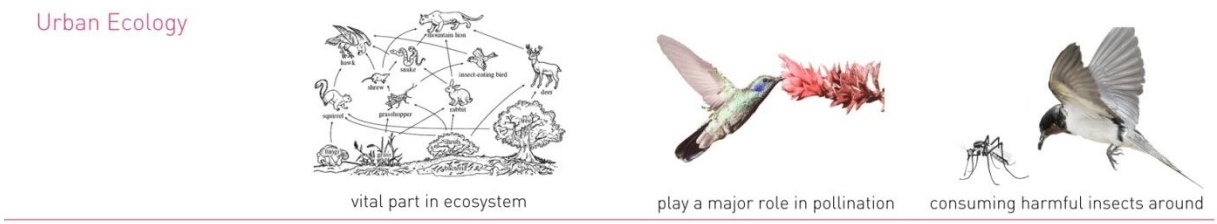

Figure 2.1: Value of urban birds

2.2 The City as Avian Habitat

Urban areas are critical for both resident and migrating birds. Resident birds share the city with humans. They build their nests in the greenery of every neighborhood. Large concentrations of birds migrate along four major flyways—Atlantic, Pacific, Mississippi, and Central—along which many large urban centers have developed. Important migratory bird habitats are often found within these metropolitan areas. [13]

Birds have nested on man-made structures for centuries. There are records of peregrines nesting on European cathedrals in the Middle Ages.[14] They can now be found nesting on skyscrapers in the Chicago Loop. Many songbirds build their nests on all parts of a building, such as light fixtures, gutters, fire escapes, and balconies.[15] Nevertheless, urban areas are extremely altered, complex systems that are designed primarily for human needs, preferences, and desires. Wildlife species in urban areas are viewed as nonessential inhabitants. Fewer and fewer stopover and nest sites for birds are left because of the destruction of their habitat. However, Jeremy T. Lundholm, in "Green Roofs and Facades: A Habitat Template Approach," described his Urban Cliff Hypothesis, which states that some species adapted to rocky habitats find urban hard-surfaced environments suitable for habitation. This indicates that urban environment have the

[13] U.S. Fish and Wildlife Service. *Urban Conservation Treaty of Migratory Birds.*

[14] Bob Sallinger, "Skyrise Nature Birds on Buildings." *Raptor Cam Blog.* 3 28, 2010. http://www.kgw.com/community/blogs/raptor-cam/Skyrise-Nature--Birds-on-Buildings.html

[15] Kelly Brenner, "A Breif History of Birds on Buildings."

potential to be functionally inhabitable for certain species. Thinking about the urban environment in this way offers new possibilities of viewing the urban environment as a new habitat rather than habitat replacement.[16] The process of urban development will be a process of creating better habitats for both human and non-human species which may contribute to a bio-diverse view of urbanism. Alternative ways of living with nonhuman animals will be considered and addressed in the landscape design approach.

Stephanie J. Melles pointed out that less formal "bottom-up" actions, such as tree plantings, community gardens, and park maintenance by community groups, families, and associations can have a profound influence on habitat creation at the local level and contribute to large-scale spatial heterogeneity.[17] Melles also emphasized the important role that every facet of land can play for wildlife. Hence, a road verge, cemetery, neglected garden, disused canal, or some other odd corner should be involved in the city planning to achieve maximum benefit.[18]

2.3 Precedent Studies in Avian Architecture

There already have been many studies and practices about preserving or creating bird habitat in natural parks or on green roofs in Chicago as well as other urban areas. While

[16] Kelly Brenner, Urban Species Profile: Peregrine Falcon." The Metropolitan Field Guide. 11 02, 2010. http://www.metrofieldguide.com/urban-species-profile-peregrine-falcon/

[17] Stephanie J. Melles, "Urban Bird Diversity as an Indicator of Human Social Diversity and Economic Inequality in Vancouver, British Columbia." Urban Habitats. n.d. http://www.urbanhabitats.org.

[18] O. L. Gilbert. *The Ecology of Urban Habitats.* Chapman and Hall Ltd, 1989.

the potential of urban interstitial spaces has been ignored to some extent, I believe the interstitial spaces around and between the buildings and streets in a city can provide opportunities to inject and insert natural life. Precedents, such as animal architecture,[19] animal estates,[20] and other competitions and practices, have addressed the awareness of designing for animals. One example is the Bird Apartment, which was installed in Komoro City, Japan at the Ando Momofuku Center. It is a tree house for humans, which is also a sanctuary for nesting birds. Visitors to the house are allowed to look into each of the 78 bird homes. This design provides the opportunity to access nature.[21] Another example is the Brick Biotope, which was designed by Micaela Nardella and Oana Tudose. It successfully creates habitat in an interstitial space with a set of brick typologies designed as a natural living environment for birds. It addresses the disappearance of the house sparrow in the Netherlands and the need for nature to reclaim the built environment. The brick is designed to be applied to a standard brick wall because the house sparrow often finds shelter in wall cracks.[22] In another project, the ProstoRož team also revitalized an interstitial space by transforming the overlooked Ljubljana fountains into a “bird fairyland” during winter, thus giving the fountain added value.

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[19] Animal Architecture. http://www.animalarchitecture.org

[20] Fritz Haeg. *Animal Estates.* http://www.fritzhaeg.com

[21] Radhika Sawhney, "Brick Biotope at FABRIKAAT:Bricks That Double as Bird Habitat Showcased in Milan," *Inhabitat,* 04 07, 2012. http://inhabitat.com/brick-biotope-at-fabrikaat-bricks-that-double-as-bird-habitats-showcased-in-milan/

[22] Sawhney, Radhika. "Brick Biotope at FABRIKAAT:Bricks That Double as Bird Habitat Showcased in Milan." *Inhabitat.* 04 07, 2012. http://inhabitat.com/brick-biotope-at-fabrikaat-bricks-that-double-as-bird-habitats-showcased-in-milan/

They furnished the fountains with a number of birdhouses of different colors. Each one had the name of a bird species found in Ljubljana. Bird food was placed there regularly until the beginning of spring.[23]

EMD Architects proposed a combined exercise in engaging birds in the production of co-species habitations in their project, Urban Aeries–Positioned Urban Roosts for Civic Habitation (PURCH). The purpose was to begin to define a new type of cross-species architectural collaboration where human and non-human architects could create an alternate method of living together in the modern world.[24] A series of prototypes were designed based on different habitation topologies of the target species.

These precedent studies showed that there is potential for exploring alternative ways of living with nonhuman animals and discussing new frameworks of ecological design. New forms of architecture and landscape may be conceptualized as habitat, leading to design strategies for non-human species. Integrating bird habitats of certain species in the built environment are necessary indicators of ecological health. Interstitial spaces have great potential as new habitats for target species that are worth studying.

[23] Prostoroz, "Ljubljana's fountains during winter," *Prostoroz*, 12, 2008. http://prostoroz.org/eng/

[24] Edward Dodington and Melissa McDonnell, "Urban Aeries/PURCH," Animal Architecture. http://www.animalarchitecture.org/urban-aeries-purch/

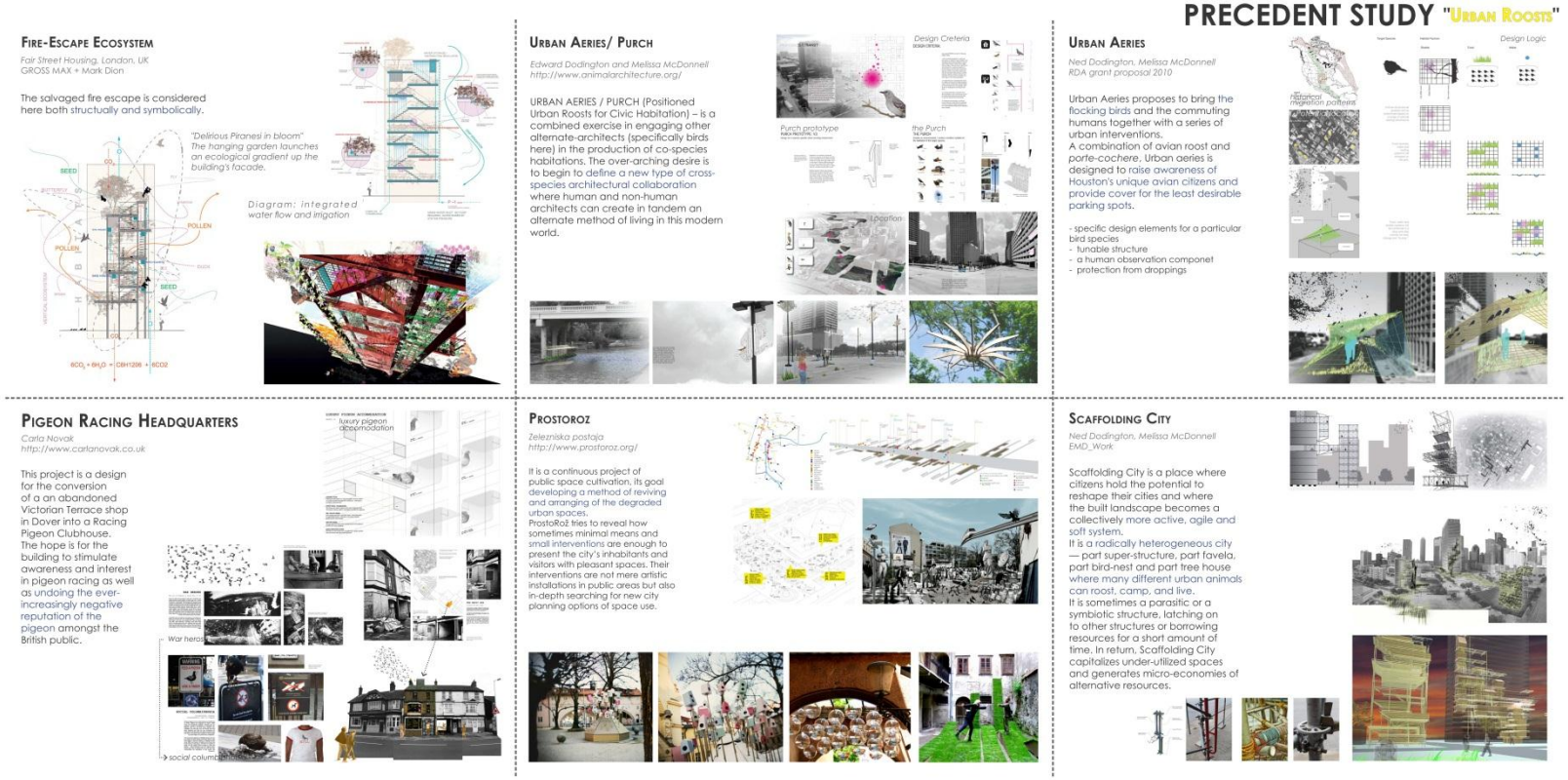

Figure 2.2: Precedent study

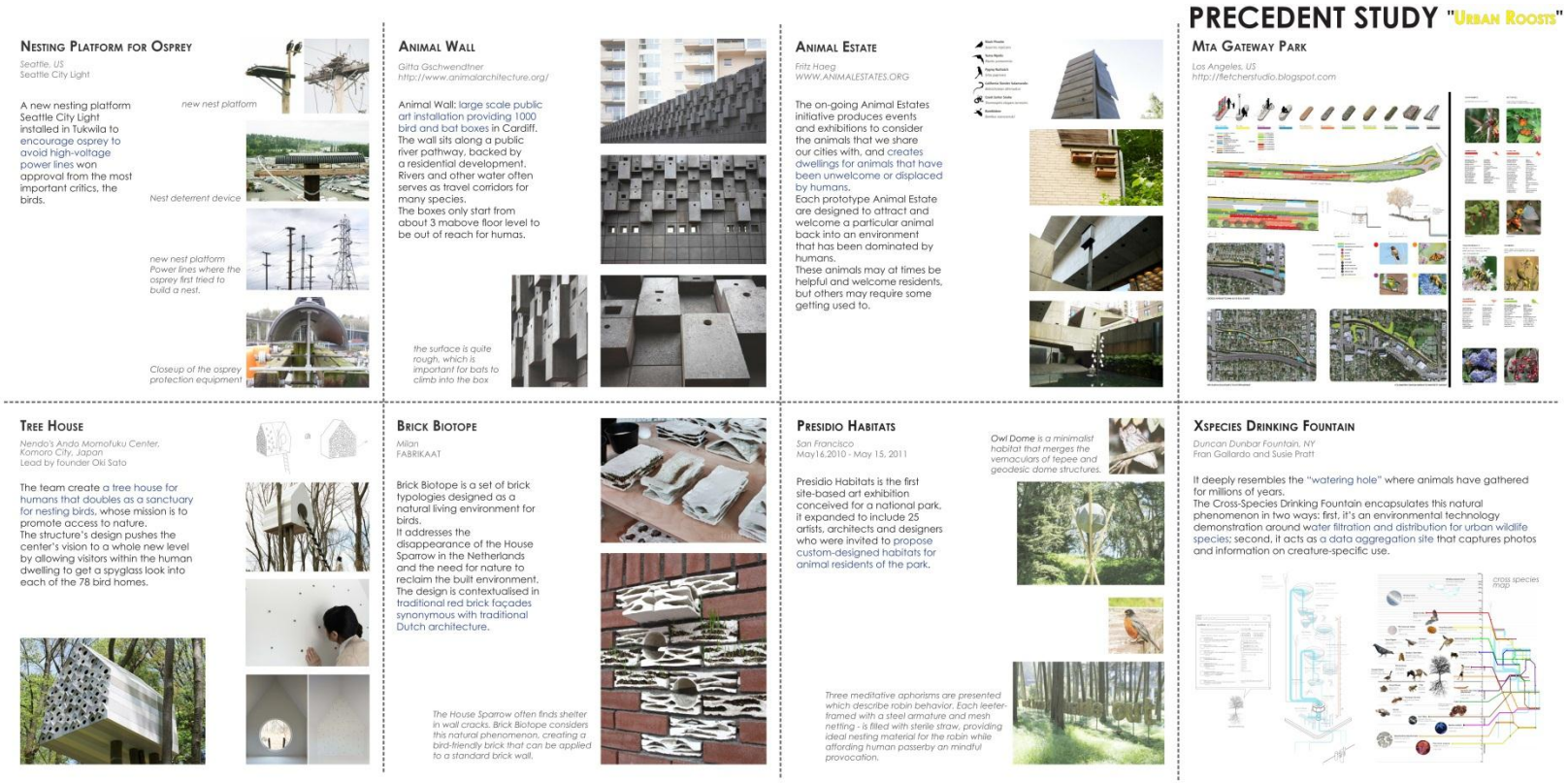

Figure 2.3: Precedent study

CHAPTER 3: INTERSTITIAL SPACE ANALYSIS

The main cause of the decline of birds in North America is loss of habitat. Besides the lands that have been protected as nature reserves or developed into parks, some underused and neglected spaces in urban interstices exist between the primary green spaces and may contribute to a bio-diverse view of urbanism. Thus, weaving avian habitats into the city's interstices could be a possible way to deal with the limitations of urban traditional green spaces. A new scale of avian habitat and landscape system may emerge during the exploration of these forgotten, fragmental, or underused urban spaces.

As defined in the Merriam-Webster dictionary, an interstice refers to a space that intervenes between things, especially between closely spaced things. The Oxford Dictionary also refers to an interstice as an intervening space, especially a very small one.

The article, *"In Urban Cracks: Interstitial Spaces In The City,"* defines interstitial spaces as generally those that cannot be found on official city maps. They usually fall between the familiar boundaries of urban planning and are often characterized by an apparent void.[25] The interstice can also be defined as a space "without precise use, located for an

[25] Eeghem, Van Elly, Riet Steel, Griet Verschelden, and Carlos Dekeyrel, 2011, "Urban Cracks: Interstitial Spaces In The City," *ISEA2011.* http://isea.sabanciuniv.edu/paper/urban-cracks-interstitial-spaces-city

indeterminate period of time between functionally determined to build configurations. The interstitial condition notably offers the possibility to learn from the experience of a new type of wilderness." [26]

Several speculative models and diagrams were produced in an effort to study the spatial topology of urban interstitial space. Photos of specific spaces were collected based on site observation in Chicago downtown, showing the possible interstitial sites in which birds may perch or nest (see figure 3-1). A series of speculative models were then made to study different types of interstices. The models showed that an interstitial space could be a space along a river, a space underneath an elevated infrastructure, a wall crack, a boundary, a space between two buildings or an alley, a concave space, an extended space around a landscape or architectural elements, a linear space along an infrastructure, a façade layer, a façade channel, or a space around an infrastructure (see figure 3-2). Finally, nine urban interstitial space typologies were determined from the above research (see figure 3-3).

To summarize, an interstitial space is the space in-between, underneath, beyond, enveloped, and outside our traditional concepts of habitat and urban space. It is the space between spaces, the space that eludes maps, an aggregate of remnants that

[26] Luc Lévesque, 2001,"Interstitial Landscape as Resources - A Few Thoughts About A Tactical Approach to Urban Intervention," *Amarrages.* http://www.amarrages.com/amarrages/amar_textes/amar_textes_eng.html

collectively represent a habitat of the in-between.

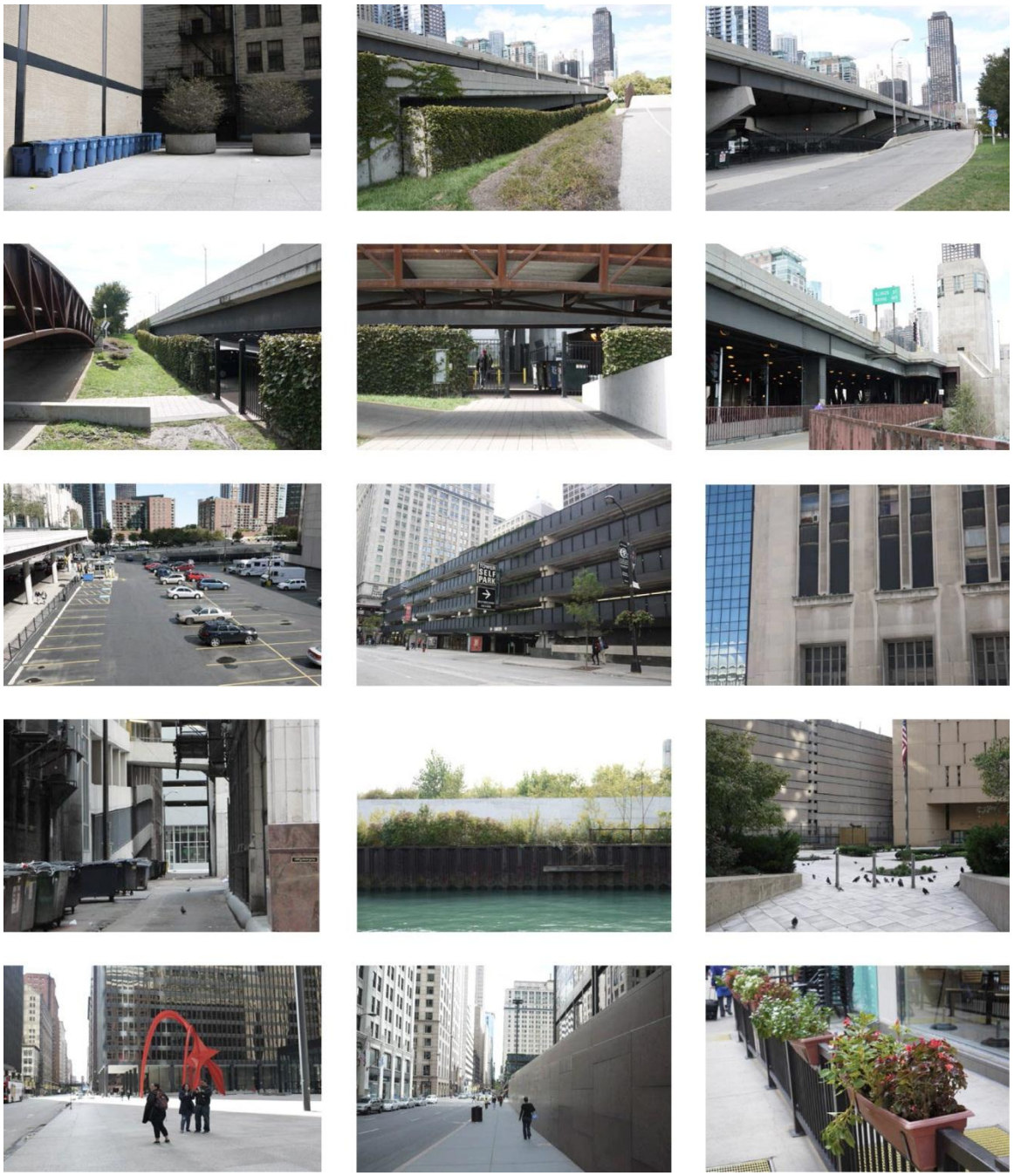

Figure 3.1: Photos of interstitial spaces in Chicago

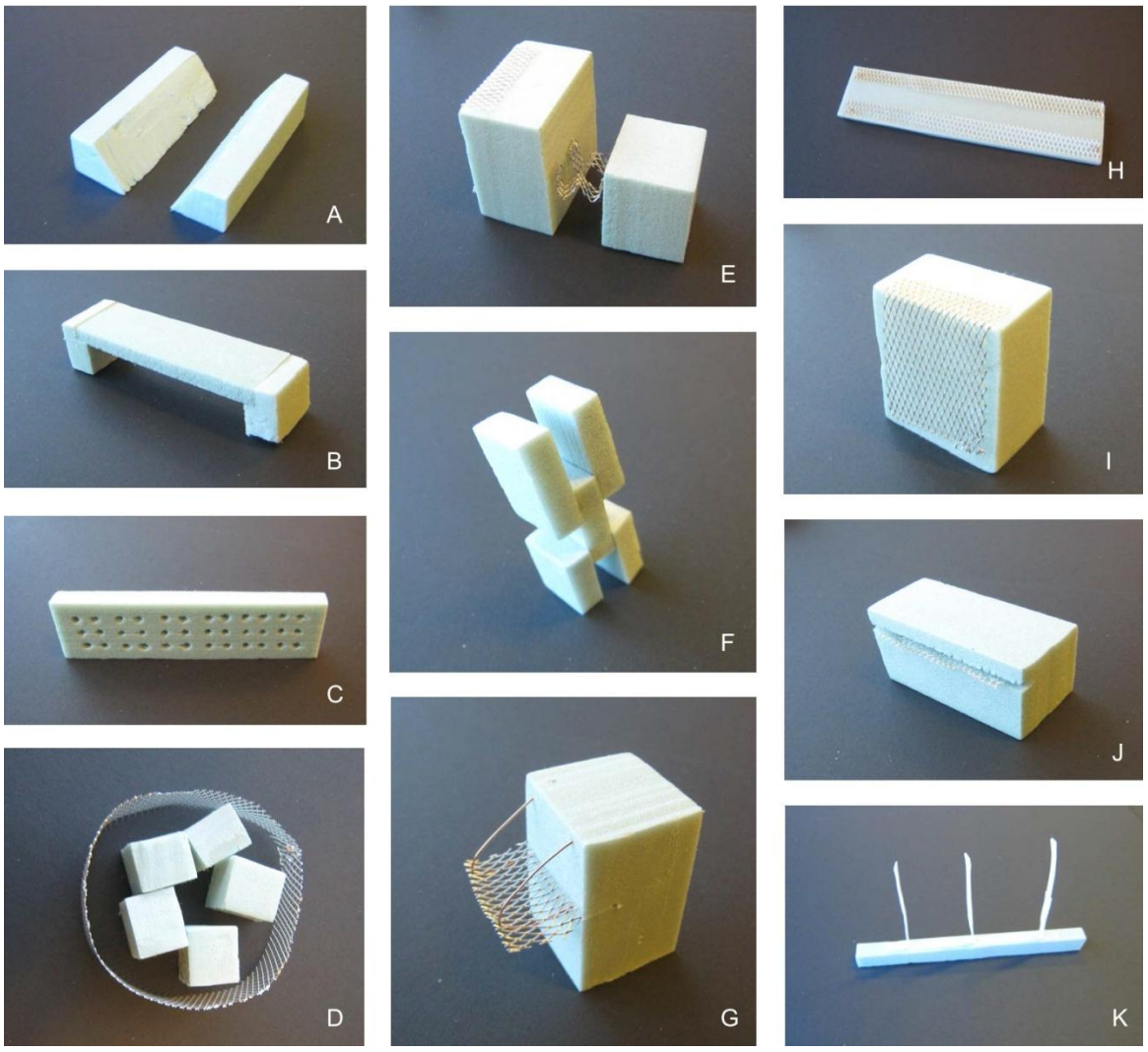

Figure 3.2: Speculative models

(A) Space along a river; (B) Space underneath the elevated infrastructure; (C) Wall crack; (D) The boundary; (E) Space between 2 architecture/alley; (F) A concave space; (G) An extended space around landscape/architecture elements; (H) The linear space along an infrastructure; (I) Façade layer; (J) Façade channel; (K) A space around the infrastructure.

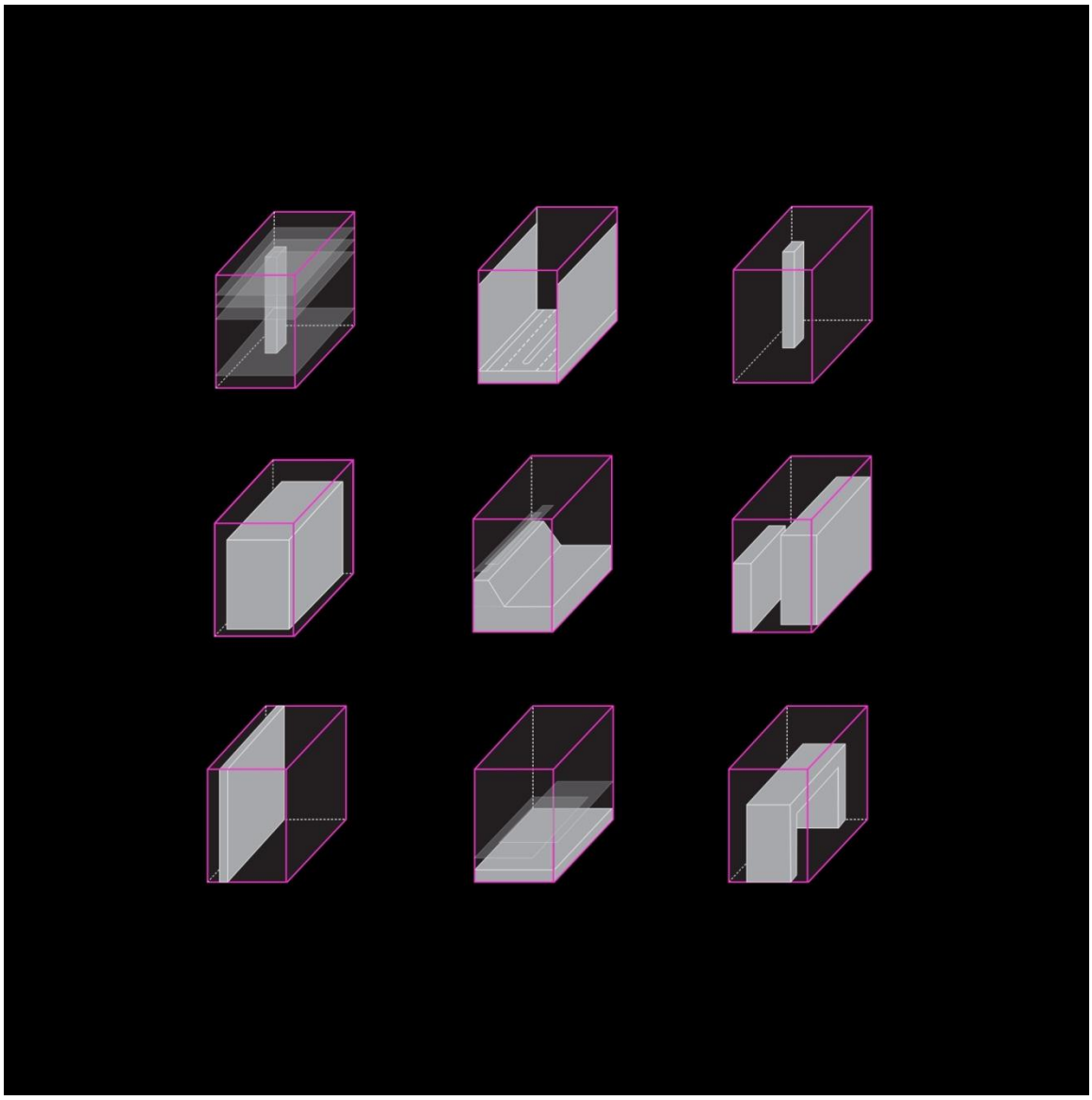

Figure 3.3: The interstitial space typology

CHAPTER 4: SITE DESCRIPTION

Birds are one of Chicago's great natural wonders. Chicago is located in the middle of the Mississippi flyway, an amazing aerial migrating path that connects the Northern and Southern hemispheres (see figure 4-1). Over 300 different kinds of birds can be found in Chicago at different times of the year. During peak migration times in the fall and spring, 250 species of migratory birds fly through the city and use its green spaces for resting and refueling. About 50 native birds also find a range of suitable habitats in which to breed.[27]

However, many species are in decline because of habitat loss or modification caused by urbanization. To ameliorate this situation, the City of Chicago has already established certain policies and actions toward creating or maintaining habitats for birds in natural reserves, parks, and green roofs. In addition, Chicago is also the home of many important bird species that nest in built environments, such as bridges, ledges, chimneys, and other urban structures.[28] However, practices concerning species that are able to survive in urban interstitial spaces are lacking. Hence, there is an opportunity to explore the potential of these spaces for the creation of bird habitats. Therefore, I selected downtown Chicago as the site for an intervention of avian architecture and habitat creation.

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[27] *Chicago's Bird Agenda,* City of Chicago, 2006.

[28] *A Habitat Guide for Chicago Land Owners: Enhancing Your Property for Birds,* City of Chicago, 2007.

Figure 4.1: Mississippi flyway
(http://migration.pwnet.org/stopovers/artic_slope.php)

CHAPTER 5: TARGET SPECIES ANALYSIS

5.1 Target Species

Living habits and habitat preference can vary considerably among different bird species. Hence, target species were selected for further design research. The *Birds of the Windy City and Chicago Bird Agenda 2006* was used to select five bird species: monk parakeets, peregrine falcons, barn swallows, northern cardinals and common mergansers. Each species has specific characteristics for observation or interaction. Based on *The Cornell Lab of Ornithology* database, the following sections describe the characteristic of the five species.

1) Monk Parakeet

According to Spreyer and Bucher, "Monk Parakeets, native to South America, are common birds in the pet trade."[29] In "Monk Parakeets: Urban Outsiders," Katherine Millett provided an overview of the life cycle of monk parakeets as well as special habits, which make them capable of surviving in the Chicago area. These birds probably escaped from pet stores or residences in the 1970s and have lived in this southern part of Chicago for 22 years. They usually build nests in colonies on tree branches, light poles, electrical poles, bridges, and satellite dishes.[30] Monk parakeets do not migrate and rely

[29] M.F. Spreyer and E.H.Bucher, "Monk Parakeet (Myiopsitta monachus)," The Birds of North America, Inc. NO.322

[30] Katherine Millett, 2003, "Monk Parakeets:Urban Outsiders," *Chicago Wilderness.* http://www.chicagowilderness.org/CW_Archives/issues/winter2003/monkparakeets.html.

on bird feeders during the winter season. However, many Chicago residents like to feed them because of their beautiful green feathers.[31]

2) Peregrine Falcon

Peregrine falcons are the official bird of Chicago. They are the largest falcon, and the females are larger and more powerful than the males are. According to Fritz Haeg, the "Adults have slate dark blue-gray wings and backs barred with black, pale undersides, white faces with a black stripe on each cheek, and large, dark eyes".[32] Powerful and fast flying, they are proficient at catching pigeons in cities in a spectacular swoop. Peregrine falcons are one of a few birds that have learned to use man-made structures, and they nest on skyscrapers in the Loop. [33]

3) Barn Swallow

Barn swallows are summer residents in Chicago. They are swift and graceful fliers, often flying just a few inches above the ground or water. The long, deeply forked tail gives them a distinctive appearance. Their mud cup nests are found on or in barns, roof eaves,

[31] Stephen Pruett-Jones, Christopher W.Appelt, Anna Sarfaty, Brandy Van Vossen, Mathew A.Leibold, and Emily S.Minor, 2011, "Urban parakeets in Northern Illinois: A 40-year perspective." *Urban Ecosyst*, 11: 30.

[32] Fritz Haeg, "ANIMAL ESTATE client 4.03/8.11: Peregrine Falcon," *Animal Estates.* http://www.fritzhaeg.com/garden/initiatives/animalestates/animals/peregrine-falcon.html

[33] R M. Daley, 2000, *Birds of the Windy City: Discover over 300 species right in Chicago*. Chicago: City of Chicago.

bridges, and other man-made structures.[34]

4) Northern Cardinal

The northern cardinal is the state bird of Illinois. They are a relatively large songbird with a thick bill, a protruding, long-tailed crest, and red coloration. These cardinals are a perfect combination of familiarity, conspicuousness, and style. They always forage on or near the ground and build their nests in low shrubs or trees.[35]

5) Common Merganser

The common merganser, a large diving duck with a long thin bill, can often be found along large lakes and rivers. They usually nest in tree cavities, either those made by large woodpeckers or in a broken limb. They will also use a nest box.[36]

These five species are analyzed by storyboards, diagrams, and montage. These three different approaches to representation are intended to achieve a comprehensive understanding of each species and communicate how they can become common characters in urban environments.

[34] Barn Swallow, The Cornell Lab of Ornithology. http://www.allaboutbirds.org/guide/Barn_Swallow/id

[35] Northern Cardinal, The Cornell Lab of Ornithology. http://www.allaboutbirds.org/guide/Northern_Cardinal/id

[36] Common Merganser, The Cornell Lab of Ornithology. http://www.allaboutbirds.org/guide/Common_Merganser/id

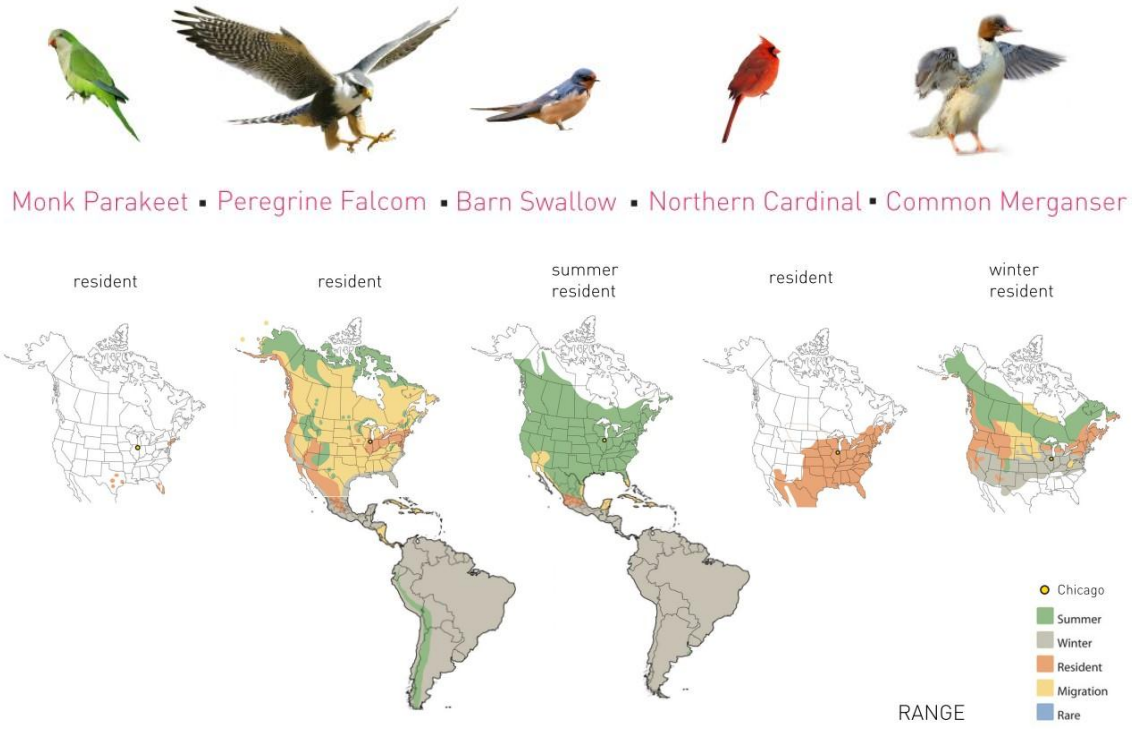

Figure 5.1: Target species and range map
http://www.audubonbirds.org

5.2 Storyboard

A series of storyboards were made to describe the unique personality and habitation of each species and its relationship with humans. These storyboards aim to offer an interesting way for citizens to build an emotional connection to the lovely creatures around us.

1) Story of the Monk Parakeet

The monk parakeet used to be a pet. One day, it escaped from the cage and then lived and thrived in an urban environment. A gentle homeless musician is befriended by a flock of wild parakeets. By feeding and taking care of them, he learned much about their unique personalities.

Figure 5.2: Storyboard of the monk parakeet

2) Story of the Peregrine Falcon

Falcons in general have a long history in folklore. In Japan, they were the symbol of victory, whereas in Greece they were sacred to Apollo. Falconry is one of the most

well-known interactions between humans and falcons.[37] Falcons perch or nest on skyscrapers, water towers, and other tall urban structures. Bird watchers are often excited about catching the moment when a falcon dives for pigeons.

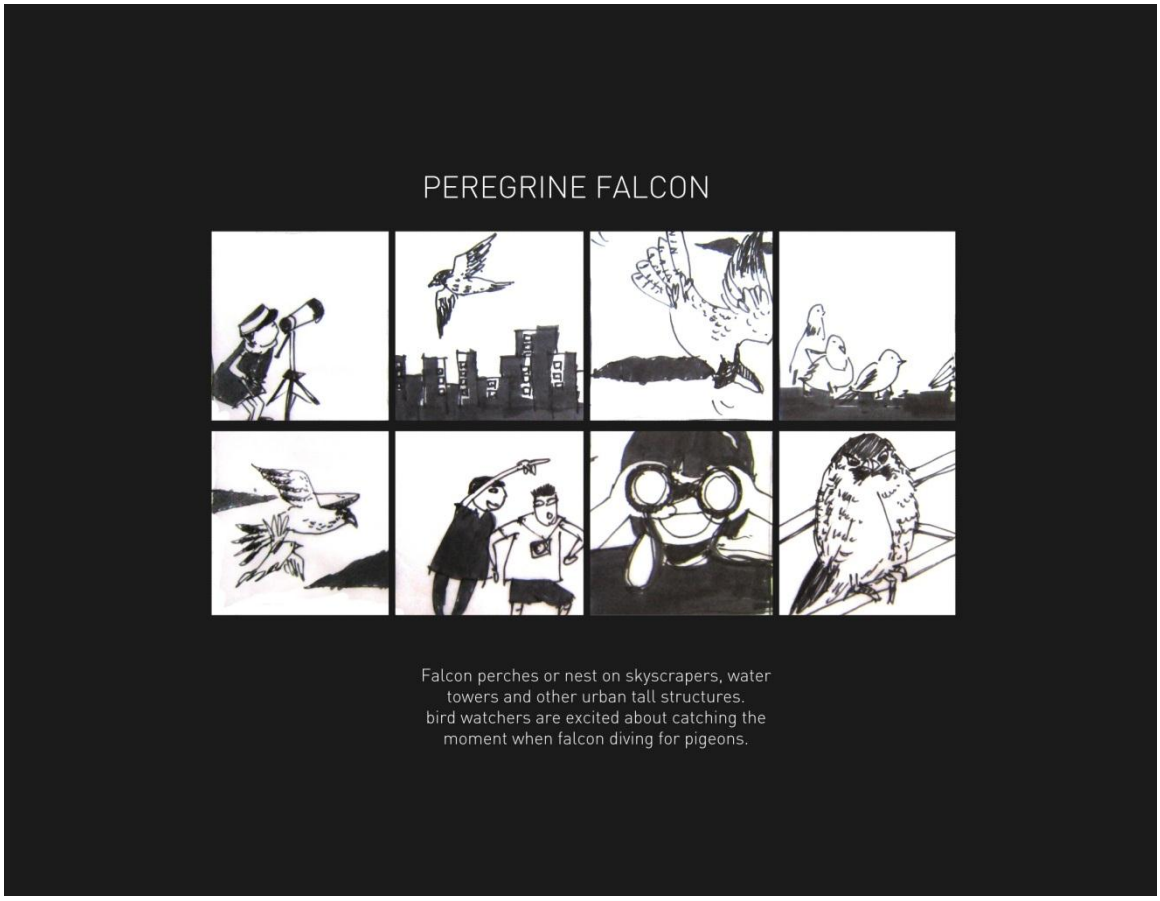

Figure 5.3: Storyboard of the peregrine falcon

3) Story of the Barn Swallow

In folklore, it is a sign of good luck when swallows nesting under the eaves. They have therefore been welcomed into barns for many generations. This belief was widespread,

[37] Brenner, Kelly. "A Breif History of Birds on Buildings."

extending from Europe to China. Even the Romans held the same belief. With their distinctive color and long forked tail, barn swallows are a joy to have under the eaves. They are also appreciated because they consume flying insects.

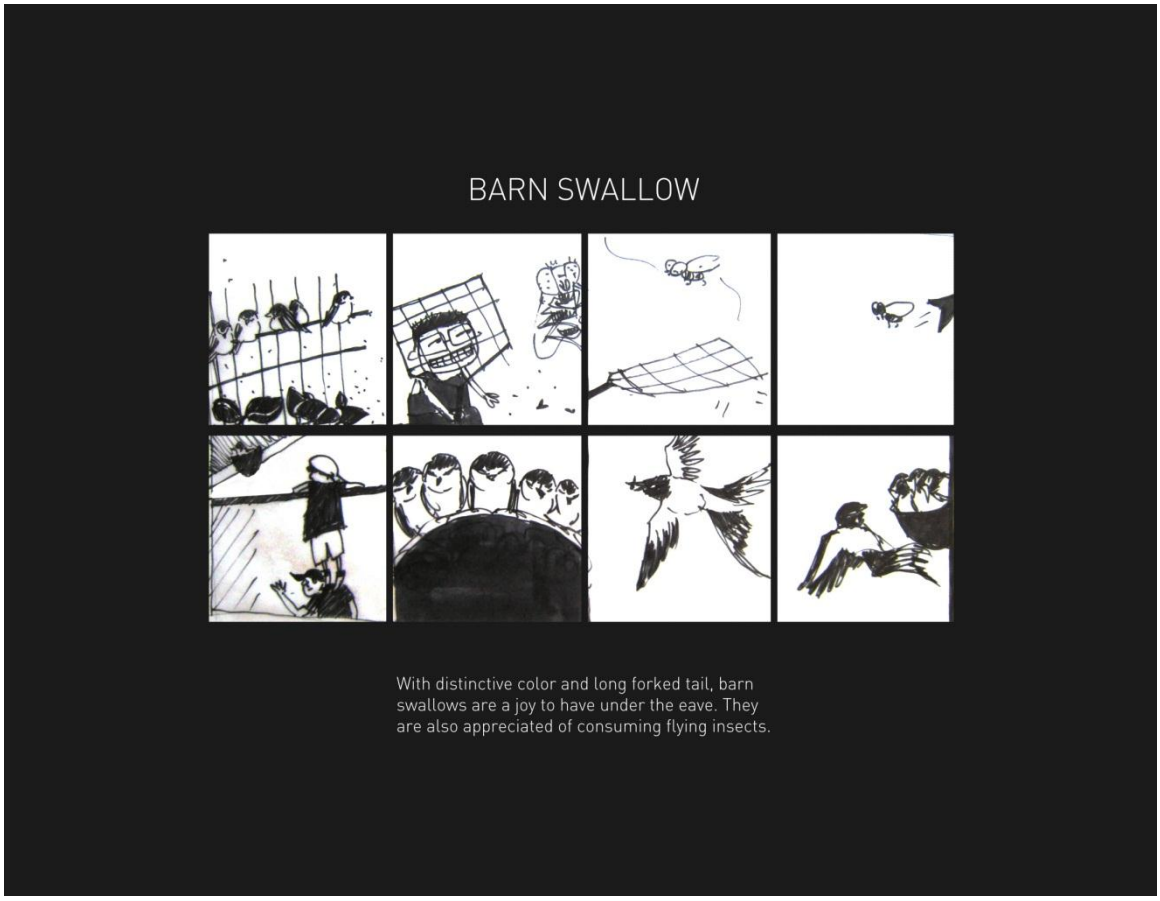

Figure 5.4: Storyboard of the barn swallow

4) Story of the Northern Cardinal

The northern cardinal is a perennial favorite among people. They tend to sit low in shrubs or trees near the ground, often in pairs. Their shade of red is breathtaking against the winter snow.

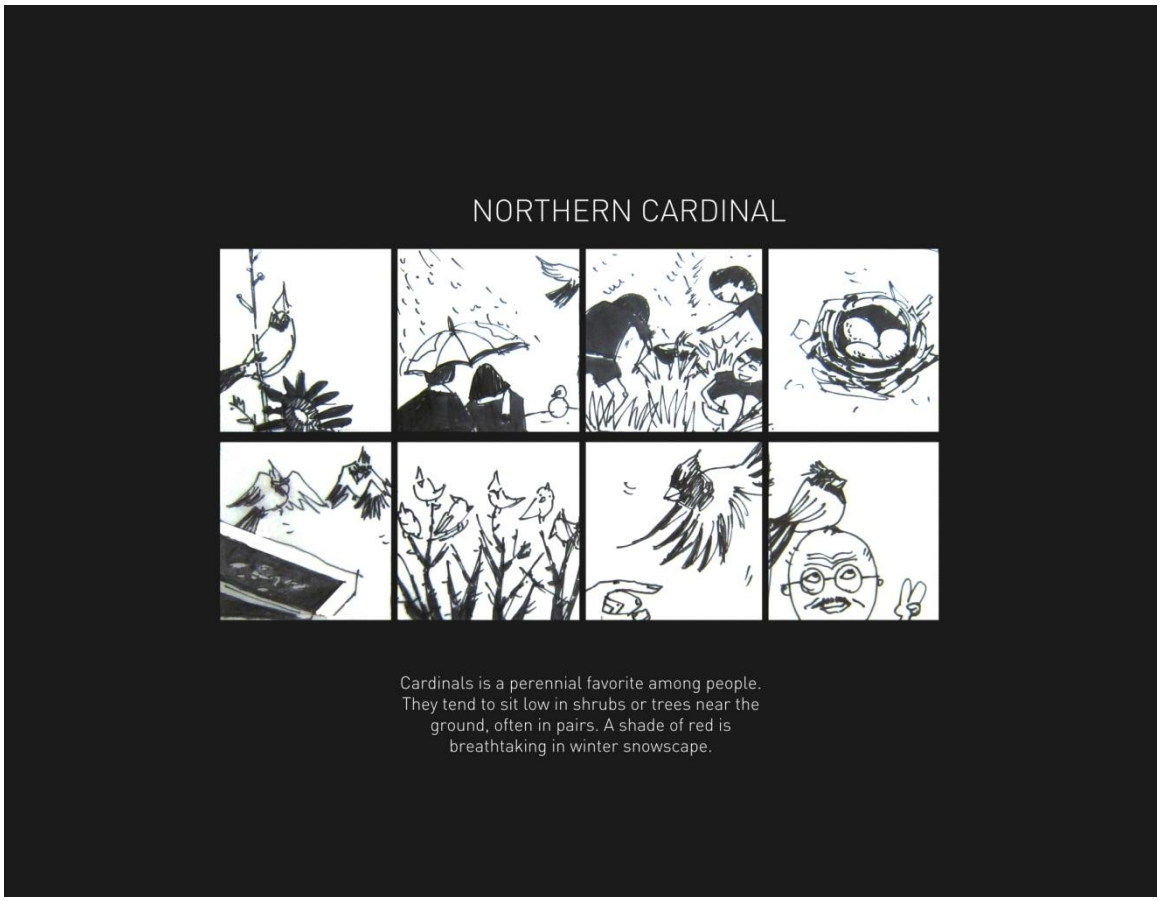

Figure 5.5: Storyboard of Northern Cardinal

5) Story of the Common Merganser

A child released his pet merganser into the wild. Several years later, they met again by the river bank. It was diving underwater to catch prey. Gulls of various species often follow flocks of foraging common mergansers. A gull was waiting for the merganser to come to the surface with a fish, and then the gull stole its fish.

Figure 5.6: Storyboard of Common Merganser

5.3 Nesting and Habitat Analysis

A montage and a detailed diagram were created for individual species. The montage is intended to convey a sense of what the landscape would be like if these birds lived in Chicago downtown and how people would interact with them (figures 5.7, 5.8, 5.9, and 5.10).

Figure 5.7: Monk parakeets in Chicago downtown

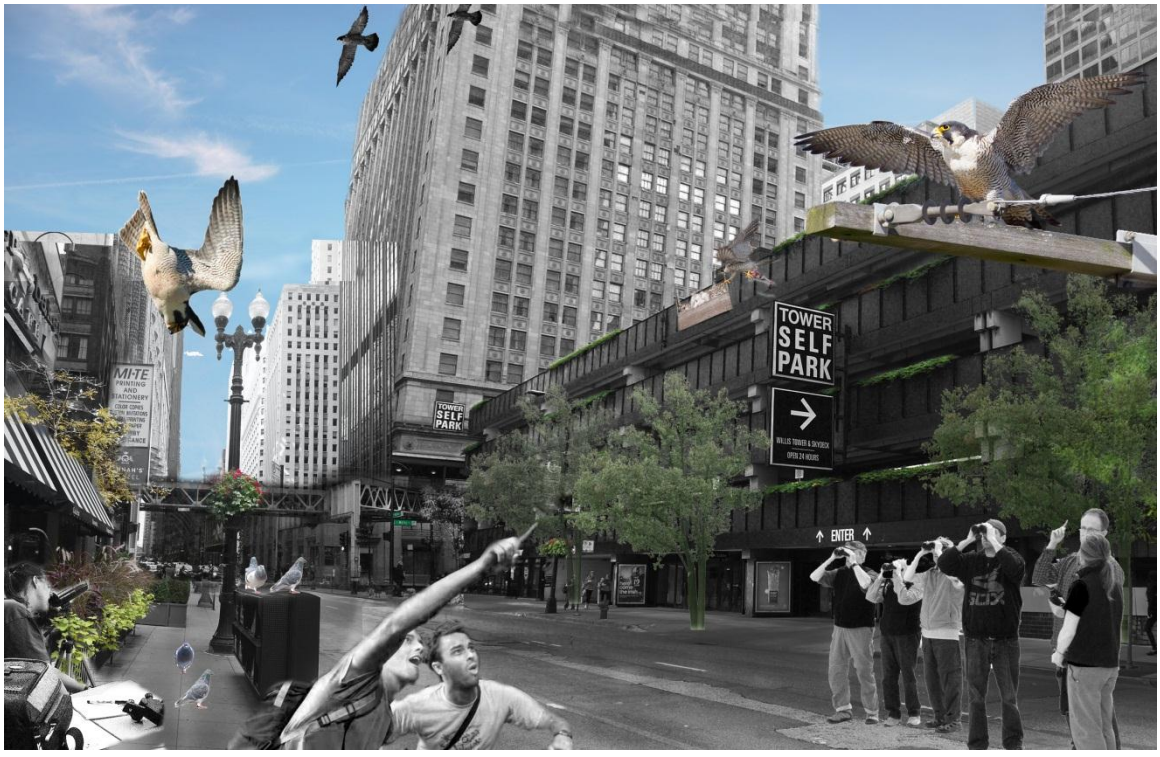

Figure 5.8: Peregrine falcons in Chicago downtown

Figure 5.9: Northern cardinals in Chicago downtown

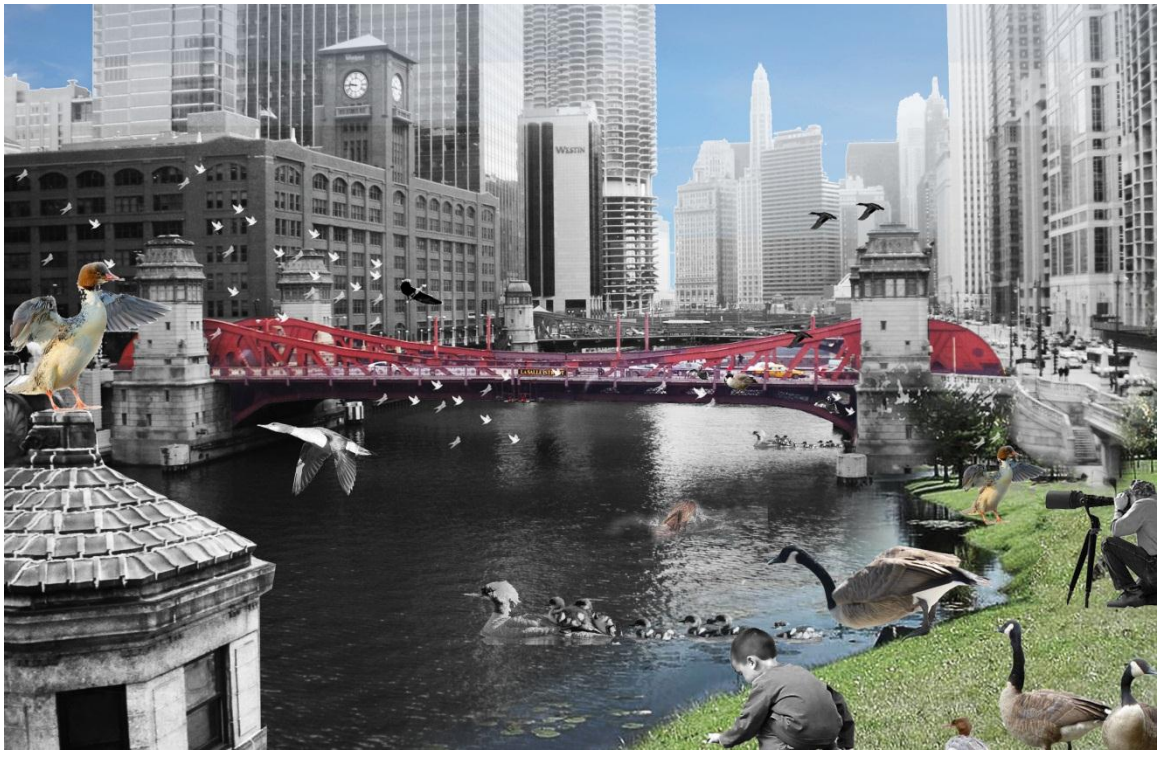

Figure 5.10: Common mergansers in Chicago downtown

The specific data of the target species are represented in diagrams that are easily understandable and visually appealing. The information shown in each diagram includes facts about habitat, diet, nest shape and size, nesting height, nest materials, nest placement, clutch size, and nesting topology (figures 5.11, 5.12, 5.13, 5.14, and 5.15).

Monk parakeets are widely distributed in urban areas. They usually build their nests in groups in trees and man-made substrates close to railroads and highways, such as light poles and cell phone towers, 20 feet to 120 feet in height. They also have the habit of building their nests on electrical poles, which may cause fires or power outages.[38] Although they breed together in the colony's nest, they do not give each other any direct help. The colony's nest, is usually 1 to 6 feet long and houses several family groups (6-20 pairs). The colony combines many individual nests that are built in close proximity to each other. Each pair enters through a separate hole in the bottom. The nests are made of only sticks, without leaves or additional materials.[39] Monk parakeets are granivorous and their diverse vegetarian diet changes seasonally according to whatever is available, such as corn, wheat, seeds, crabapples, berries and so on.[40]

[38] Katherine Millet, "Monk Parakeets: Urban Outsiders."

[39] Peter Goodfellow, 2011, "Colonies & Group Nests." In *Avian architecture : how birds design, engineer & build*, edited by Peter Goodfellow, 122, 130. Ivy Press.

[40] Monk Parakeet, The Cornell Lab of Ornithology. http://www.allaboutbirds.org/guide/Monk_Parakeet/id

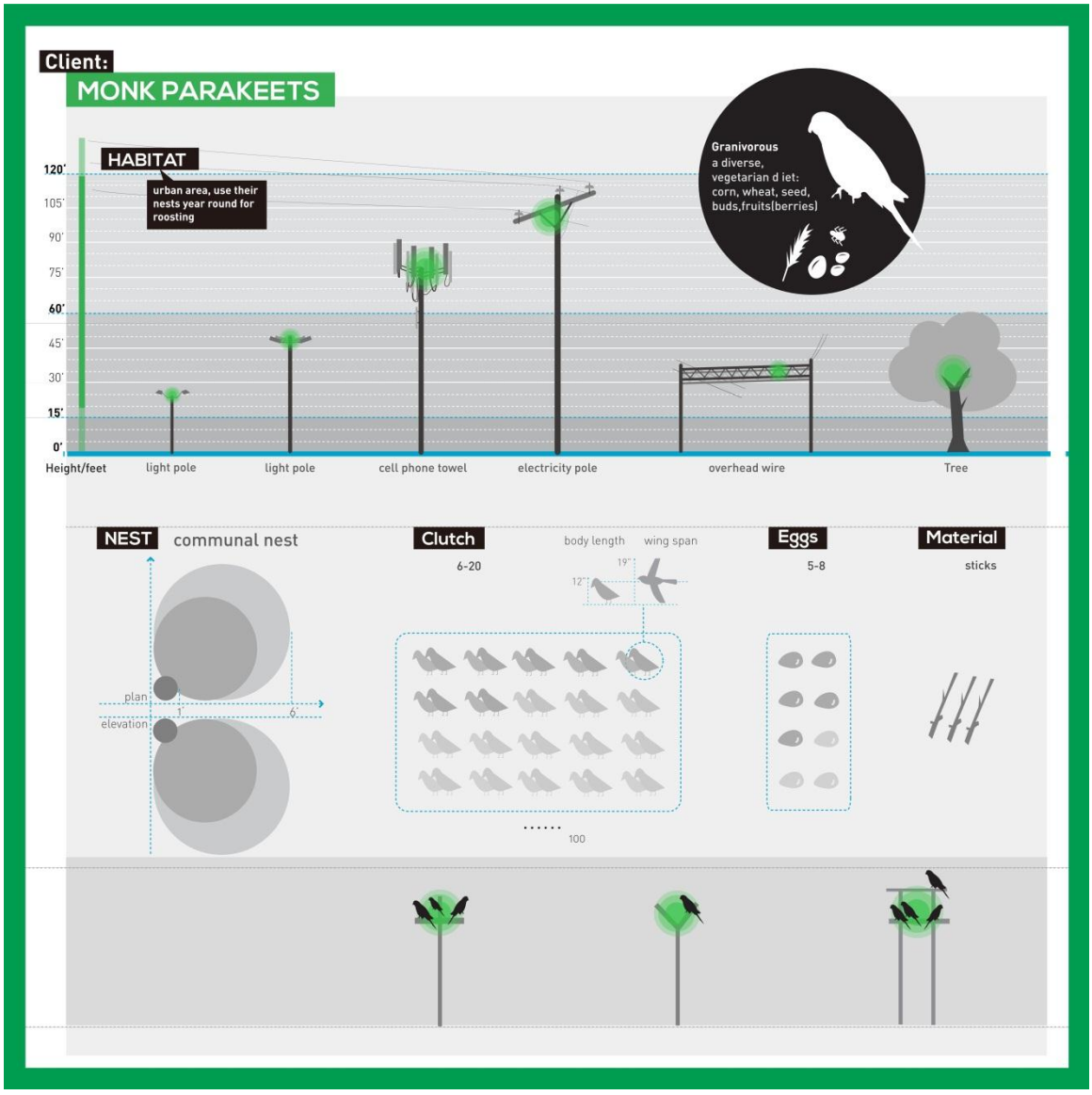

Figure 5.11: Profile of the monk parakeet

In their natural setting, peregrine falcons nest on a cliff ledge. When they were introduced to cities, they found that tall buildings were artificial cliffs. In addition, pigeons, which make up their primary food source, were extremely accommodating and

moved in on their own.[41] They now also perch or nest on skyscrapers, water towers, bridges, and other tall structures in urban settings throughout the world.[42] They are usually found nesting at elevations from 75 feet to 300 feet. The nests are placed in a little depression in the soil, gravel, debris, or other substrate after scraping the nest ledge. The scrapes are about 9 inches in diameter and 2 inches deep. Peregrine falcons eat an enormous variety of birds. In urban areas, they subsist mainly on pigeons .[43]

[41] Kelly Brenner, 2010, "Urban Species Profile: Peregrine Falcon," *The Metropolitan Field Guide,* accessed November 02, 2010. http://www.metrofieldguide.com/urban-species-profile-peregrine-falcon/.

[42] Bob Sallinger, "Skyrise Nature Birds on Buildings."

[43] Peregrine Falcon, The Cornell Lab of Ornithology, http://www.allaboutbirds.org/guide/Peregrine _Falcon/id

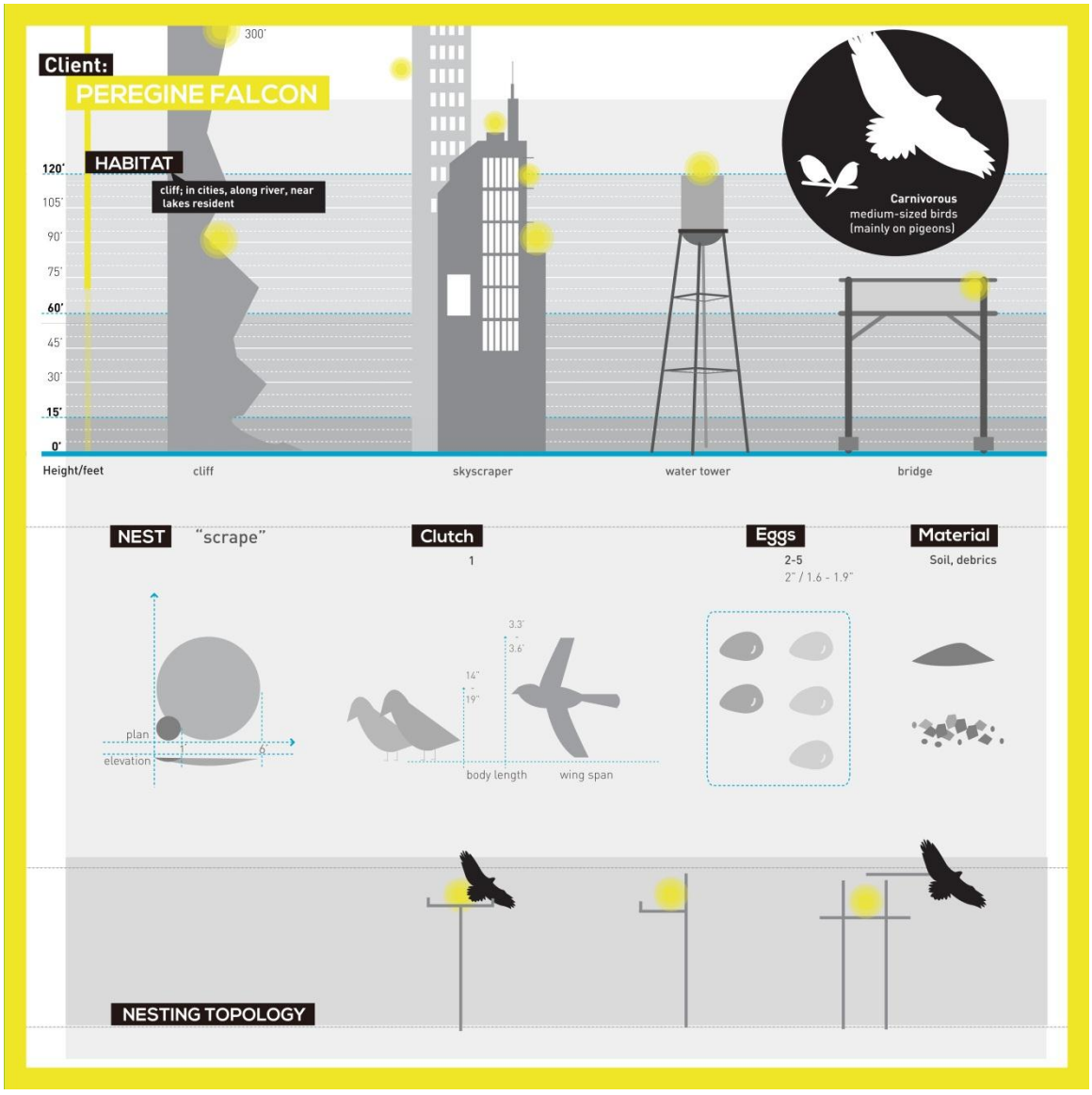

Figure 5.12: Profile of the peregrine falcon

Barn swallows feed in open habitats in fields, parks, roadway edges, marshes, meadows, ponds, and coastal waters. They build cup-shaped nests almost exclusively on human-made structures, under eaves and wharfs or inside sheds, barns, bridges and other structures. They may also attach their nests to tree trunks in the shelter of the branches. The solid, cupped nests are made of mud and reinforced with grass, and then

lined with feathers and soft plant material.[44] Built on a horizontal surface, the nests form a complete cup about 3 inches in diameter and 2 inches deep. If it is built against a wall or other vertical surface, the nest will be a semicircular, half-cup shape. Barn swallows feed on all types of flies in addition to beetles, bees, wasps, ants, butterflies, moths, and other flying insects from just above the ground or water to heights of 100 feet or more. [45]

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[44] Barn Swallow, *National Audubon Society*. http://birds.audubon.org/birds/barn-swallow

[45] Barn Swallow, *The Cornell Lab of Ornithology.* http://www.allaboutbirds.org/guide/Barn_Swallow/id

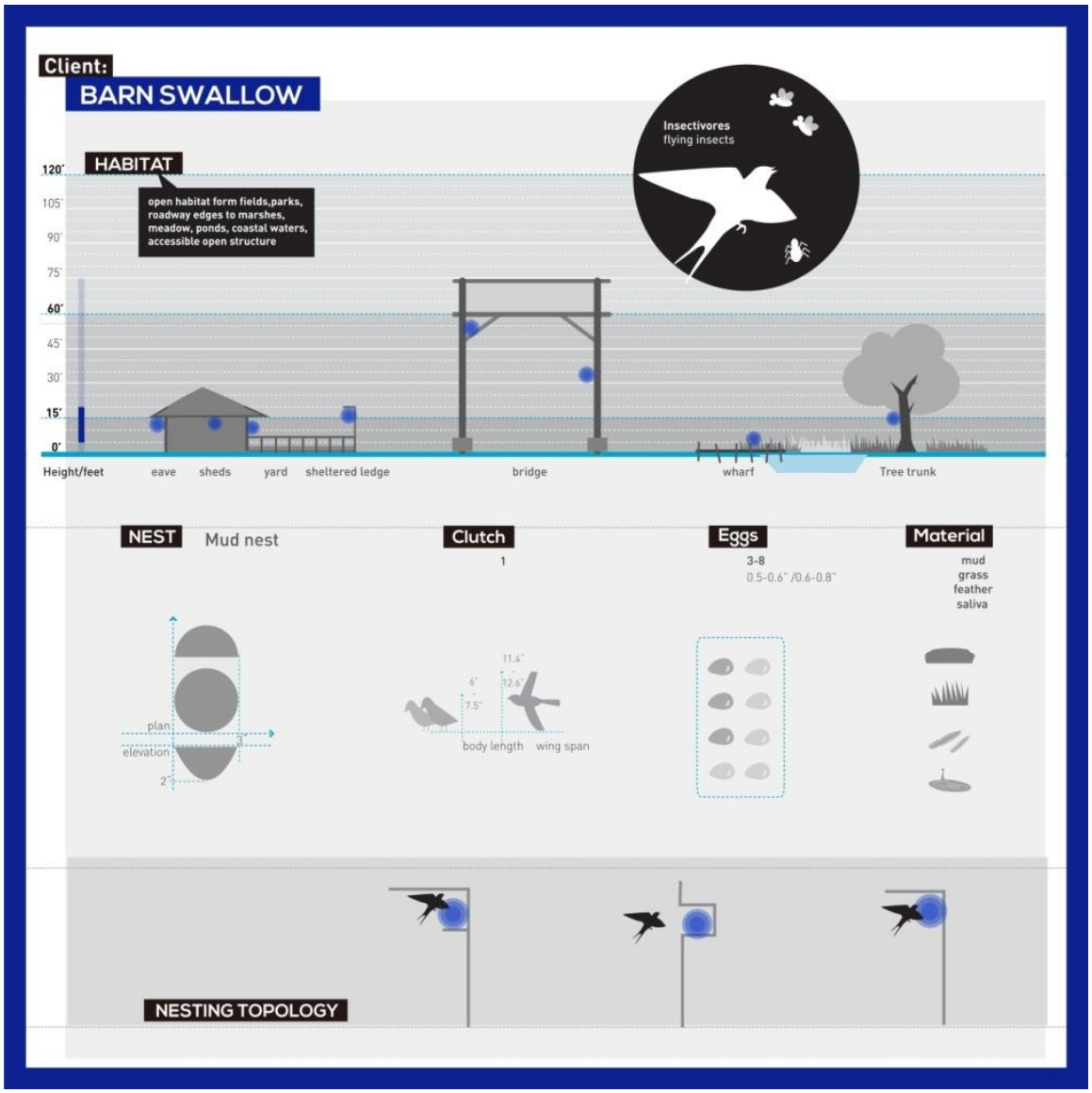


Figure 5.13: Profile of the barn swallow

Northern cardinals inhabit dense, shrubby areas, such as woodland edges, thickets, brushy swamps, gardens, and backyards. They nest from 1 to 15 feet high in dense foliage and prefer conspicuous, fairly high perches for singing. Built with coarse twigs covered with a leafy mat, lined with grasses, stems and fibers, their cup-shaped nest is 3 to 4 inches tall, 4 inches across, with an inner diameter of about 3 inches. Cardinals

usually do not use their nests more than once. Seeds and fruit make up the majority of the northern cardinal's diet, which it supplements with insects. Common fruits and seeds are dogwood, wild grape, buckwheat, grasses, sedges, mulberry, hackberry, blackberry, sumac, tulip-tree, and corn.[46]

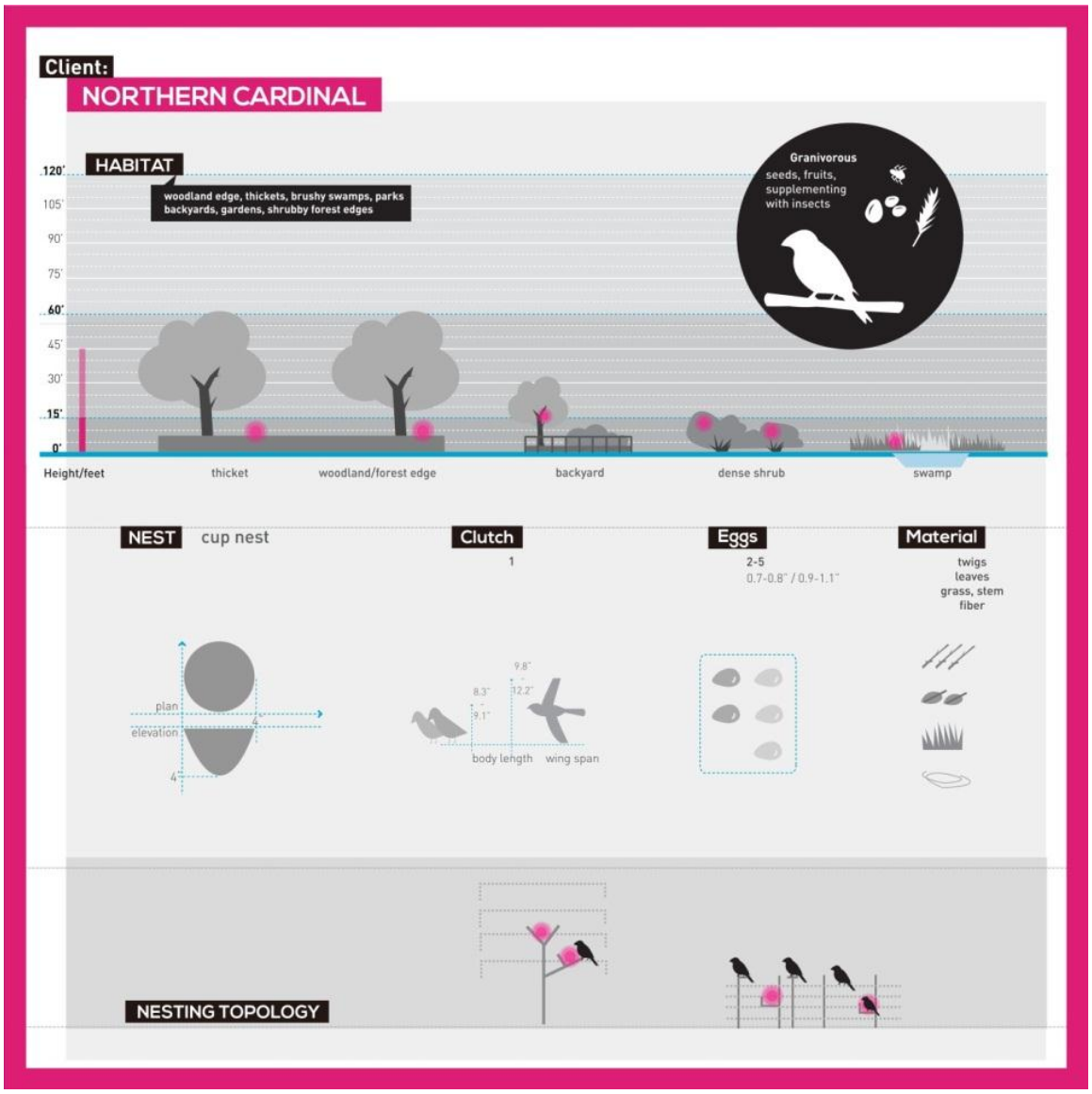


Figure 5.14: Profile of the northern cardinal

[46] Northern Cardinal, The Cornell Lab of Ornithology. http://www.allaboutbirds.org/guide/Northern_Cardinal/id

Common mergansers breed by wooded rivers, lakes, and ponds. They usually make their nests in a tree cavity and sometimes on the ground or in an abandoned hawk's nest.[47] They will also use a nest box. Infrequently, a common merganser might make its nest in a rock crevice, a hole in the ground, a hollow log, in an old building, or in a chimney. Common mergansers are omnivorous, feeding on plants, small fishes, insects, mollusks, crustaceans, worms, frogs, small mammals, and birds.[48]

[47] Common Merganser, *National Audubon Society.* http://birds.audubon.org/birds/common-merganser

[48] Common Merganser, The Cornell Lab of Ornithology. http://www.allaboutbirds.org/guide/Common_Merganser/id

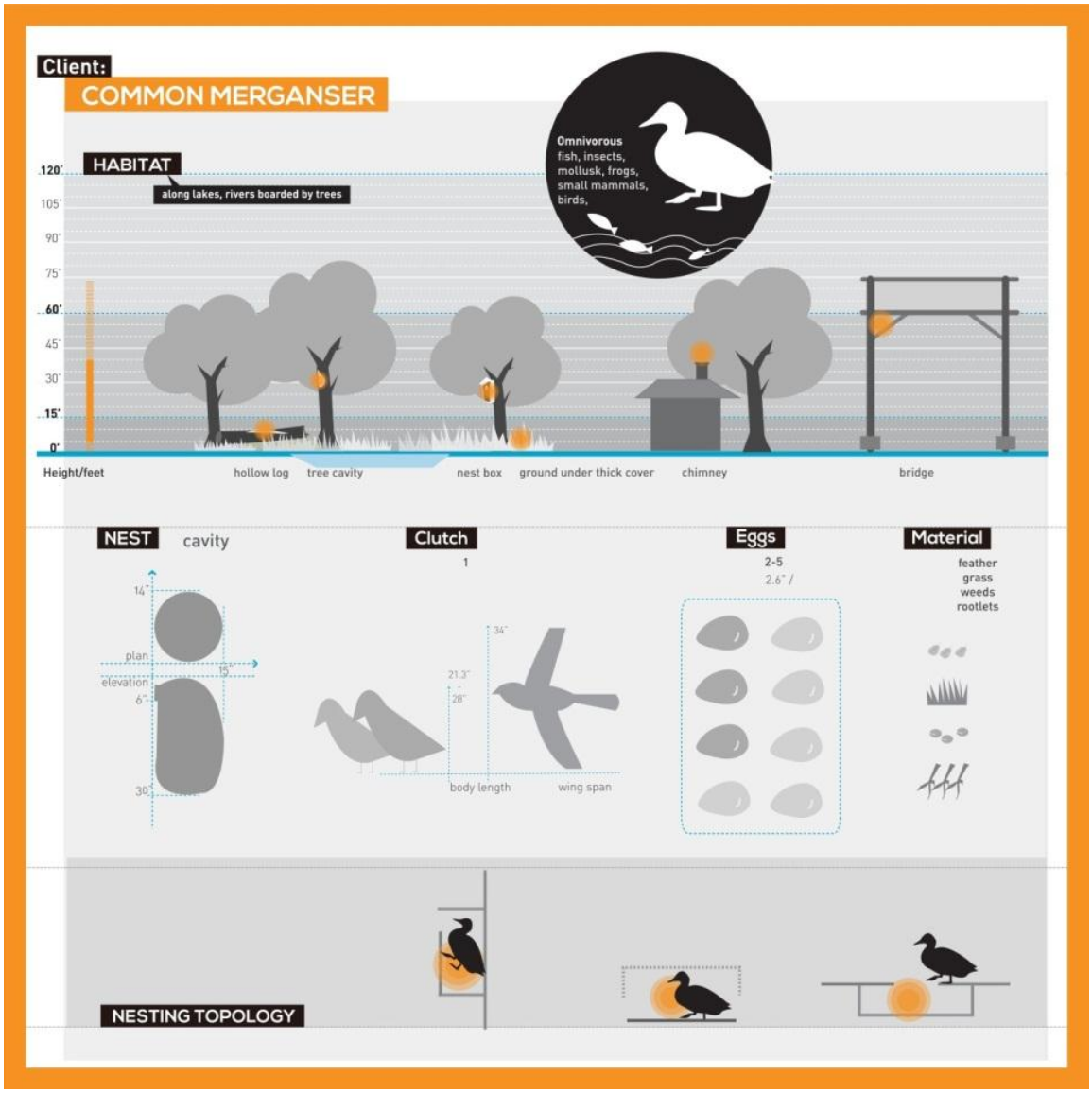


Figure 5.15: Profile of the common merganser

CHAPTER 6: HABITAT DESIGN CRITERIA AND NESTING PROTOTYPES

6.1 Proposed Design Criteria

According to the analysis of each species' habitat requirements, and its eating, resting, and nesting behaviors in urban settings, a series of general plans can be made for the design of interstitial habitats.

The following are the basic design factors for the nesting sites in the interstitial spaces, which need to be considered for all five species:

- Plantation of native trees, shrubs, and perennial flowers is required.
- Specific layered plantings, including canopy, under-story, shrub, and ground cover need to be incorporated into the site to attract birds by providing their food source and shelter.
- A water source needs to be considered for birds.
- A landing perch needs to be included in the design for certain species.
- Protection from predators should be considered.
- Protection from extremes of weather should be considered.
- Protection from the waste of the birds need to be integrated into the design.
- A structure that embraces change and flexibility will be considered for the inhabitable site because it will be very difficult to design an ideal habitat for a target species. Therefore, design flexibility is necessary.
- The component of bird watching for humans can be integrated if possible.

- For inclusion in the interstitial space, different interface devices should be designed for the nesting prototypes.
- In selecting the sites. it should be kept in mind that artificial light and glass windows are serious hazards, especially for young, inexperienced birds.

6.2 Urban Avian Nesting Prototypes

This thesis suggests five urban nesting prototypes for the selected bird clients. The design of each prototype is based on the analysis of the five target species discussed in Chapter 5. These prototypes are not the only suitable options, but are specifically suitable to the target species. They are recommended to be put into certain interstitial spaces in downtown Chicago in order to help create a new type of urban habitat. The prototypes highlight the existence of an overlooked urban ecosystem and at the same time, the prototypes will become part of the urban landscape.

1) Prototype I

This design is based on eight inserted boxes, which comprise a nesting wall that is attached to a building facade or placed separately in an outdoor space at a height between 20 to 100 feet. The nesting wall provides a group dwelling for monk parakeets, which also increases their interaction with humans. Humans are allowed to look into each of these bird homes through peepholes on the boxes. The other side of the boxes is open for the entry and exit of the monk parakeets (see figure 6-1).

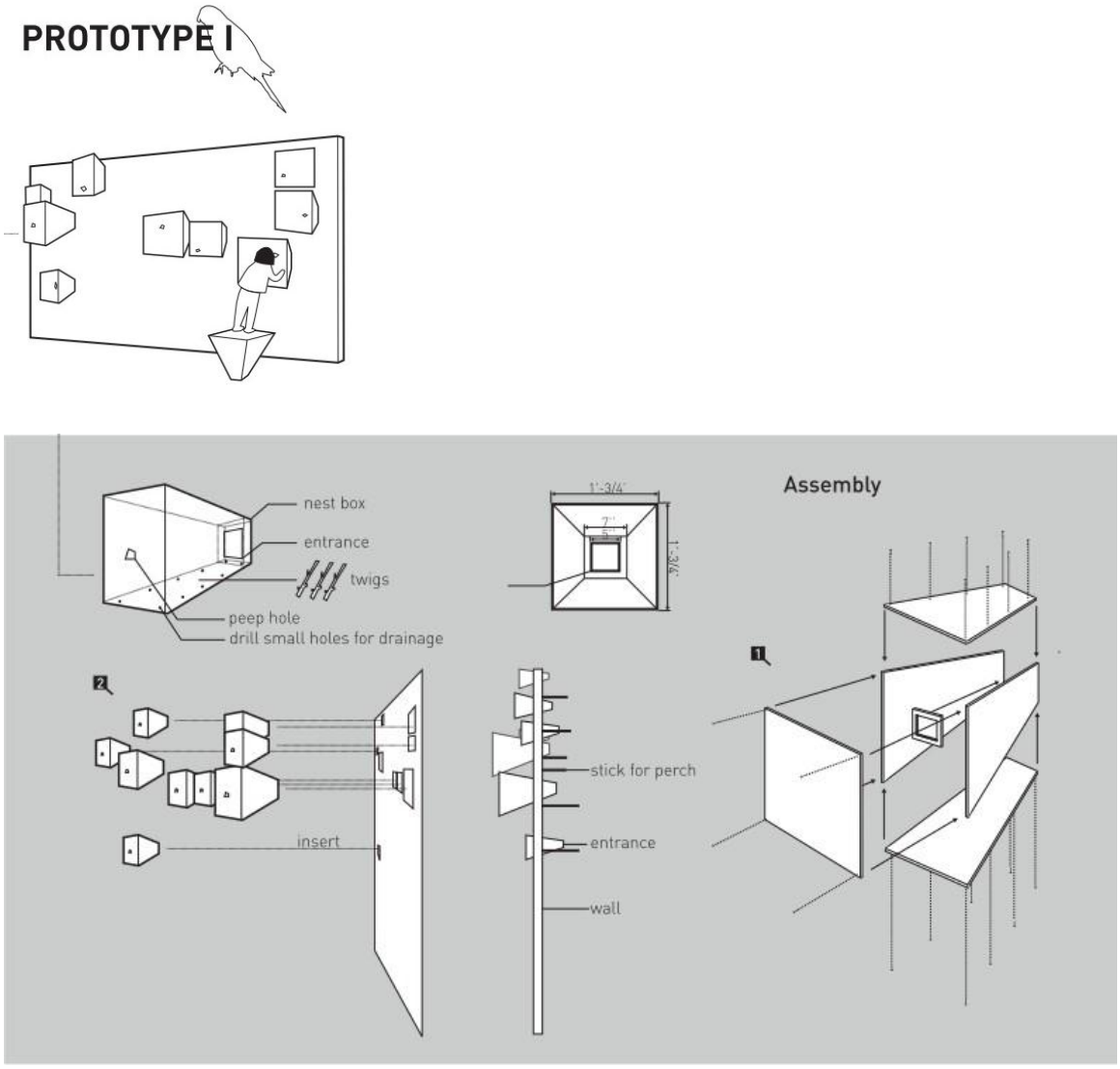
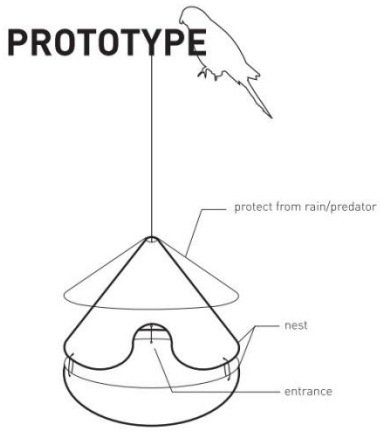


Figure 6.1: Nesting prototype I for the monk parakeet

2) Prototype II

Prototype II is designed for attachment to man-made structures on which monk parakeets often build their nests, such as light poles, walls, and bridges. The prototype needs to be installed at a height between 20 to 100 feet. The individual nest is made of three parts: a bowl-shaped bottom and a cone-shaped cover. Nine of these nests are

suspended from a hanger-shaped structure, forming a colonial nest that can be occupied by 9 pairs of parakeets (see figure 6-2).



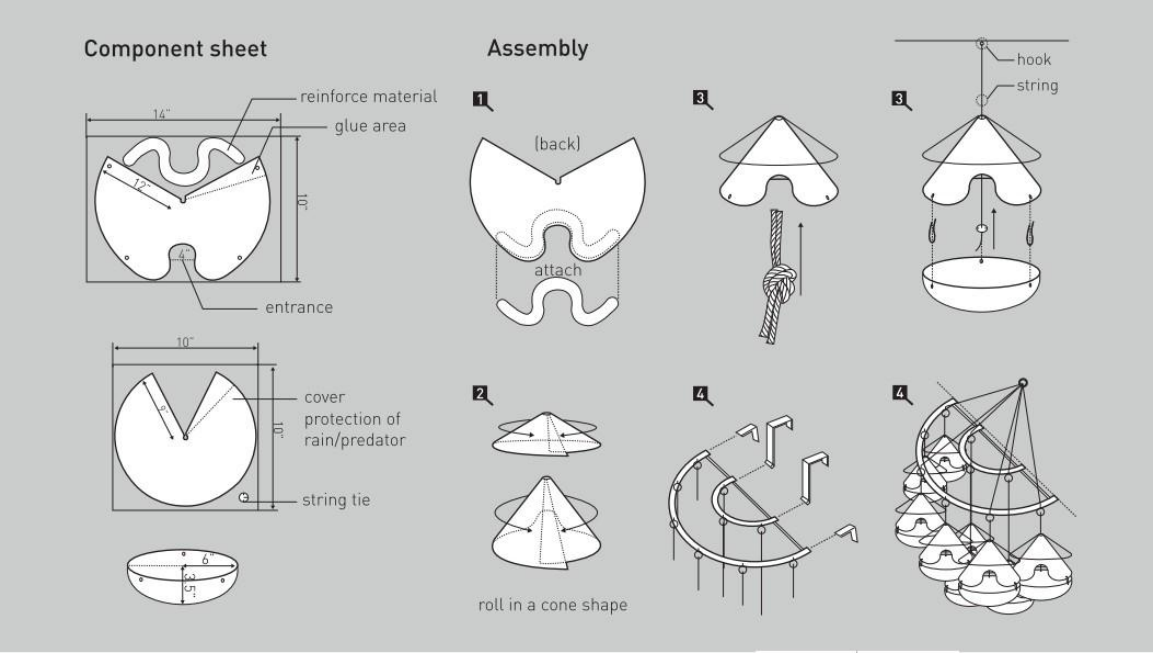


Figure 6.2: Nesting prototype II for the monk parakeet

3) Prototype III

When peregrine falcons choose building sites in urban settings, their nests often require

some sort of box or other modification to prevent the eggs and the fledglings from falling to the ground.[49] Therefore, to offer the necessary protection, a wooden nest box about 26 inches in diameter with a curved edge from 6 to 16 inches high was created. It is important to put about 4" gravels of nesting substrate into the box to avoid egg punctures. Fifteen to 20 small evenly spaced holes were drilled in the bottom for drainage. The box was put into a frame with an overhead cover and will be attached to a building. Two long sticks provide perches for the falcons (see figure 6-3). Cameras can be placed over the nests to record the falcons' activities, which are then relayed onto big screens so that people can get a close view of the city's falcons in addition to watching them through telescopes.

[49] Fritz Haeg, "ANIMAL ESTATE client 4.03/8.11: Peregrine Falcon."

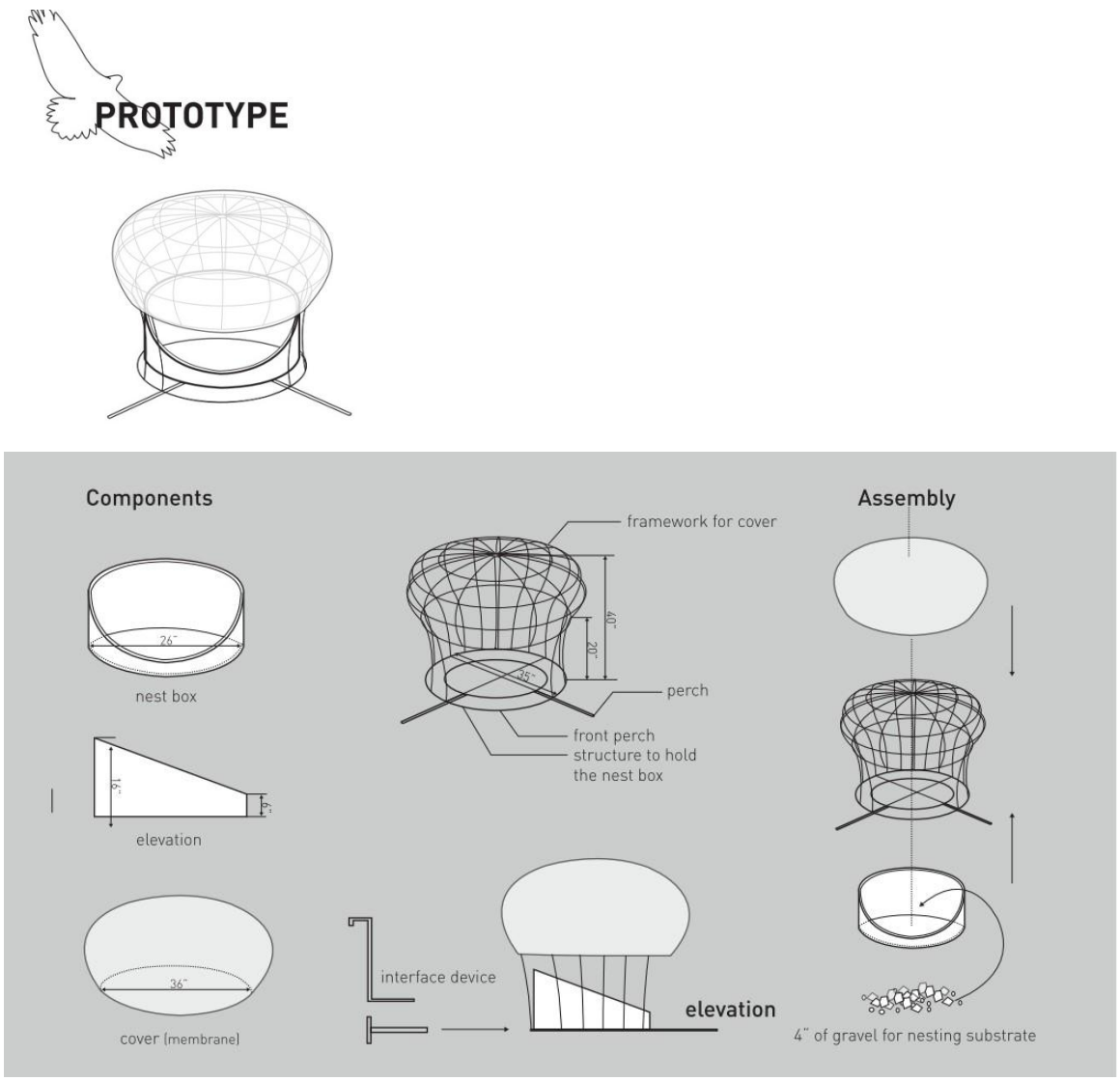


Figure 6.3: Nesting prototype III for the peregrine falcon

4) Prototype IV

Prototype IV is a simple sheet of cardboard or wood. Once the sheet is rolled into a cup shape, it will be inserted under an eave or a bridge. It can also be hung on a tree lower than 20 feet high with partial sun and shade, which barn swallows prefer. A landscape structure was also designed for the northern cardinal. It is a wooden frame that

resembles tree branches. The cupped nests are integrated into the structure. The cups may also be used for other purposes, such as a plant pot. An adjustable cover was added to hold rainwater and lessen the bright sunshine to create places that are as comfortable as the shade of a tree (see figure 6-4).

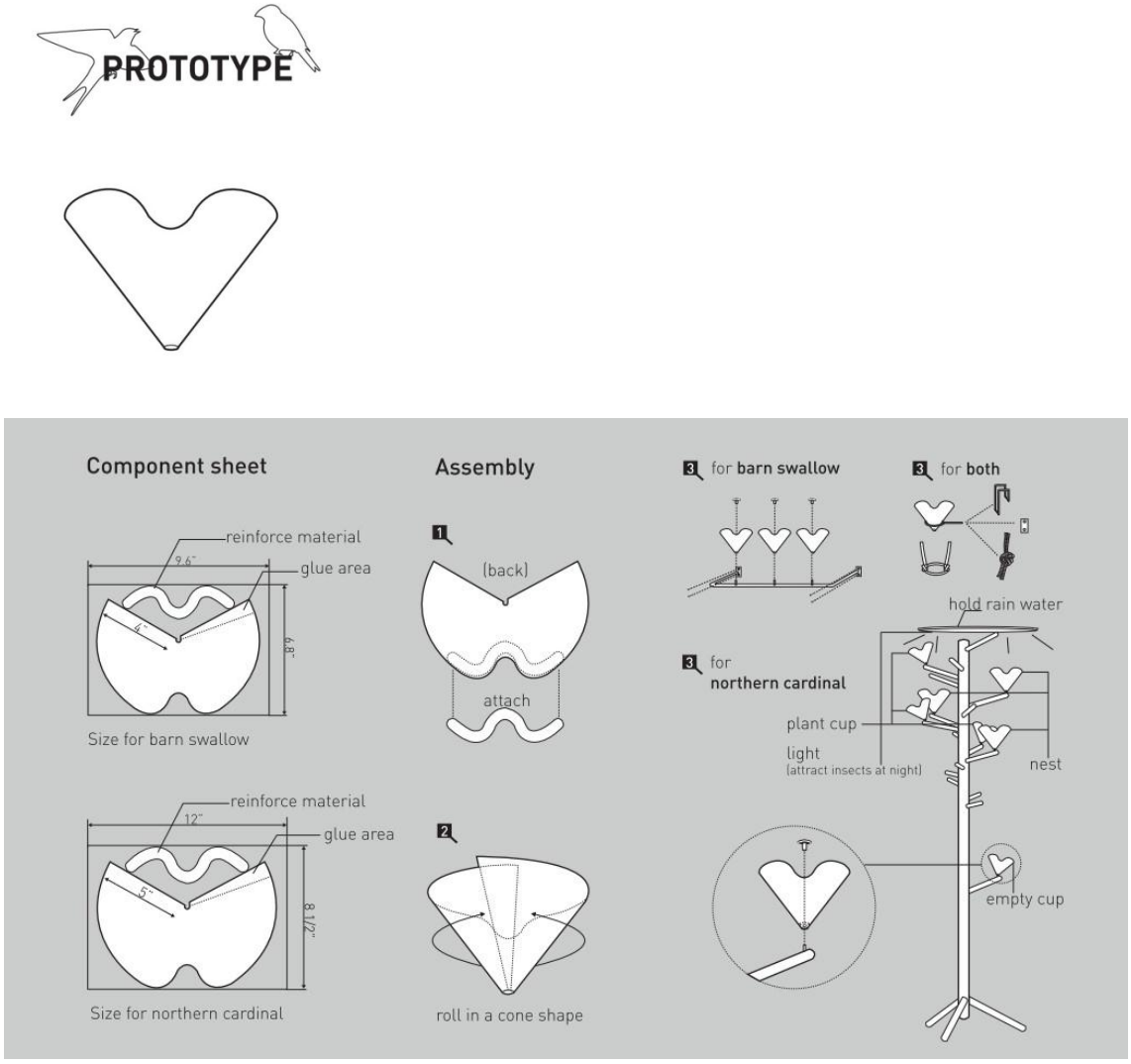


Figure 6.4: Nesting prototype IV for the barn swallow and the northern cardinal

5) Prototype V

This prototype is a wooden nest box designed for common mergansers. It has an entrance about 7 inches wide. In the bottom, 10 small holes were drilled for drainage. When a frame is added, it can be placed among vegetation on the ground or attached to a tree trunk near lakes and rivers. A small platform and sticks for perching were added (see figure 6-5).

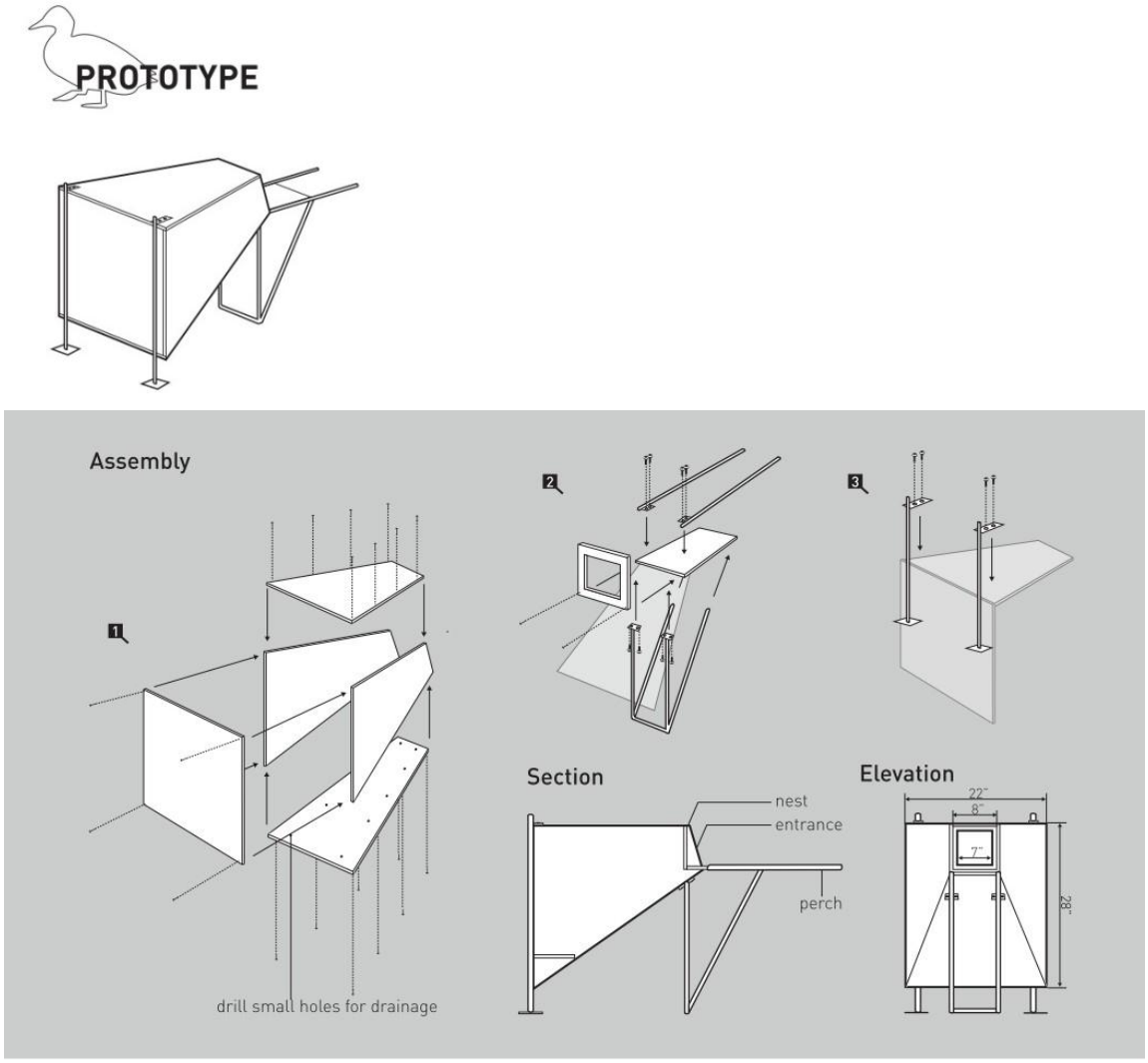


Figure 6.5: Nesting prototype V for the common merganser

CHAPTER 7: MAPPING THE INTERSTITIAL HABITAT

7.1 Habitat Suitability Index

The HSI (Habitat Suitability Index) is a numerical index that represents the capacity of a given habitat to support a selected species by combining the interactions of all key environmental variables on a species' vital and survival rates.[50] Useful details from HSI models are selected and summarized. They can serve as a basis for increased understanding of species-habitat relationships, and thus help narrow down the suitable living areas in downtown Chicago for each target species.

The followings are the key points of the HSI of the five target species:

1) Monk Parakeet:[51]

- Substrates mostly trees and built substrates
- Nesting height: 20-120'
- Suitable substrate to support large and heavy nests
- Proximity to foraging areas
- Distance to railroad tracks (55-1890 meters)
- Distance to nearest body of water (76-6,665 meters)
- % canopy cover (0-20)

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[50] "Habitat Suitability Index (HSI)." *U.S.Environmental Protection Agency.* 9 2008. http://www.epa.gov/aed/html/research/scallop/hsi.html

[51] Stephen Pruett-Jones, Christopher W.Appelt, Anna Sarfaty, Brandy Van Vossen, Mathew A.Leibold, Emily S.Minor. "Urban parakeets in Northern Illinois: A 40-year perspective." *Urban Ecosyst*, 11 30, 2011.

2) Peregrine Falcon:[52]

- Vertical face 75-300’ high
- Ledge >10 square feet
- Indentation for nesting
- Southern exposure
- Overhang
- Proximity to a major river/lake, or marsh <0.5 mile
- Sensitivity to human disturbance

3) Barn Swallow:[53]

- Mast height 5’-20’
- Accessible open structures
- Need for Shelter
- Need for open areas for foraging
- Foraging range within 200 meters in height
- Need for a source of mud

4) Northern Cardinal:[54]

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[52] *Wildlife and Fish Habitat Capability Models: Appendix E.* US Forest Service, n.d., 13.

[53] Barn Swallow, *The Cornell Lab of Ornithology.*

[54] Richard N.Conner, Mary E.Anderson, James G.Dickson. "Relationships among territory size, habitat, song, and nesting success of Northern Cardinals." 1 1986: 23-31.

- Areas with few trees
- Dense foliage from the ground to 3 meters
- Arthropod biomass

5) Common Merganser:[55]

- Proximity to water adjacent forest
- Possible nest locations: the ground, cavity trees, nesting boxes, old buildings or chimneys
- Nesting Height in trees (0.6-17m)
- Distance from human activity
- Need for loafing and foraging space

7.2 Proposed Location

On the basis of each species' habitat suitability index, and the eBird database which has the map of bird watching hotspots, twenty specific interstitial sites have been selected for avian habitat creation (see figure 7.1). Design prototypes will be established in a variety of environments in downtown Chicago. Figure 7.2 illustrates a matrix showing how these 5 prototypes of 5 target species will be integrated into different types of urban interstitial space.

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[55] Sandilands.A.P. "The birds of Ontario: habitat requirements, limiting factors and status." In *The birds of Ontario: habitat requirements, limiting factors and status*, by Sandilands.A.P., 120-123. UBC Press, 2005.

Because urban ecological systems are characterized by complex interactions among social, economic, institutional, and environmental variables, it is hard to determine whether the placement proposed here would provide a positive effect on the urban environment. In practice, these prototypes should be installed gradually for testing and observation. Several assumptions and ideas can only be tested during application. The first is the optimal quantity of installation sites. Now it is simply determined by the author guided by the habitat requirements. The second is the ecological effect of prototypes, whether they are effective and appropriately occupied by target species.

Figure 7.1: Suggested locations for prototypes in downtown Chicago

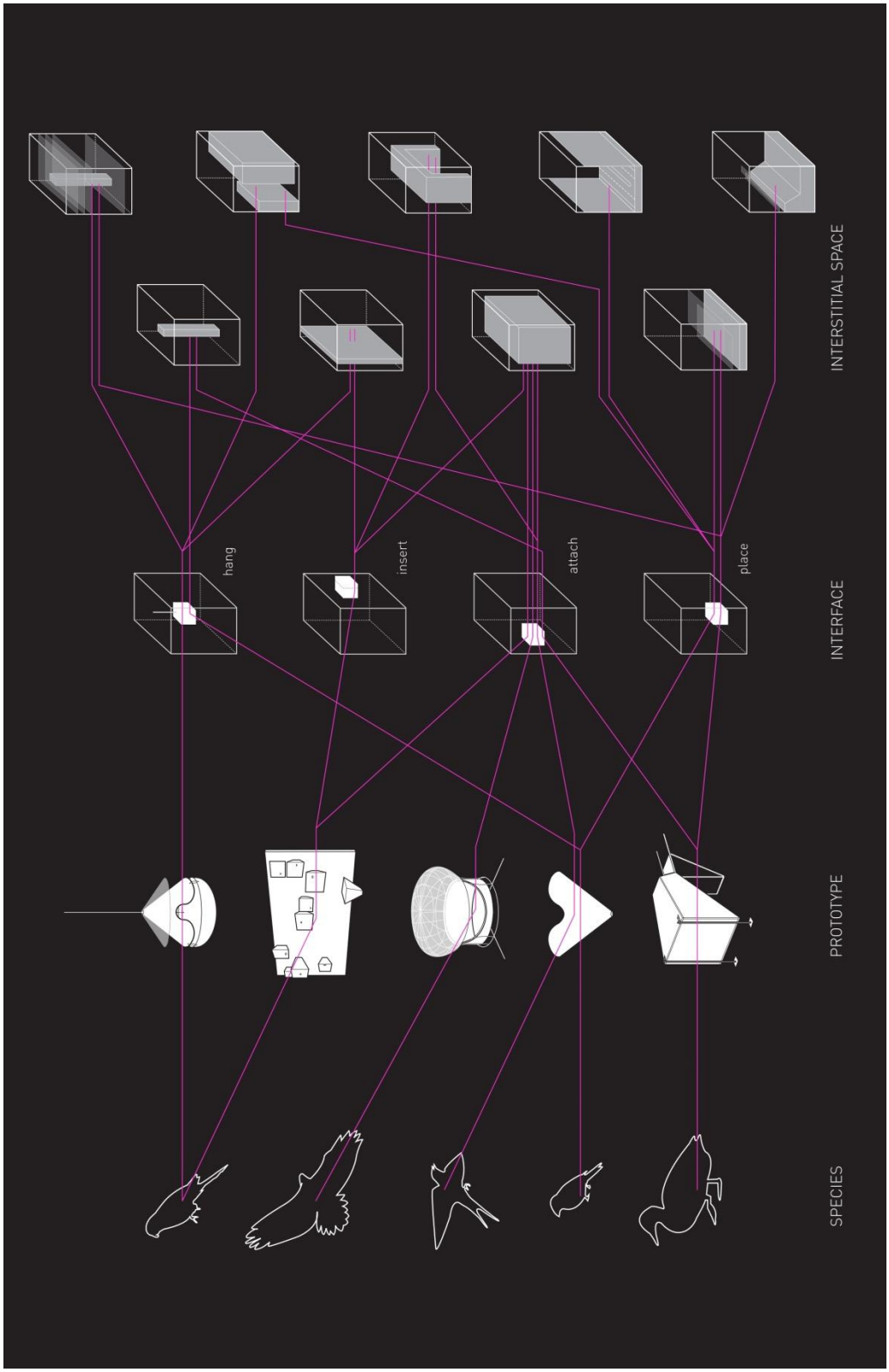

Figure 7.2: Matrix

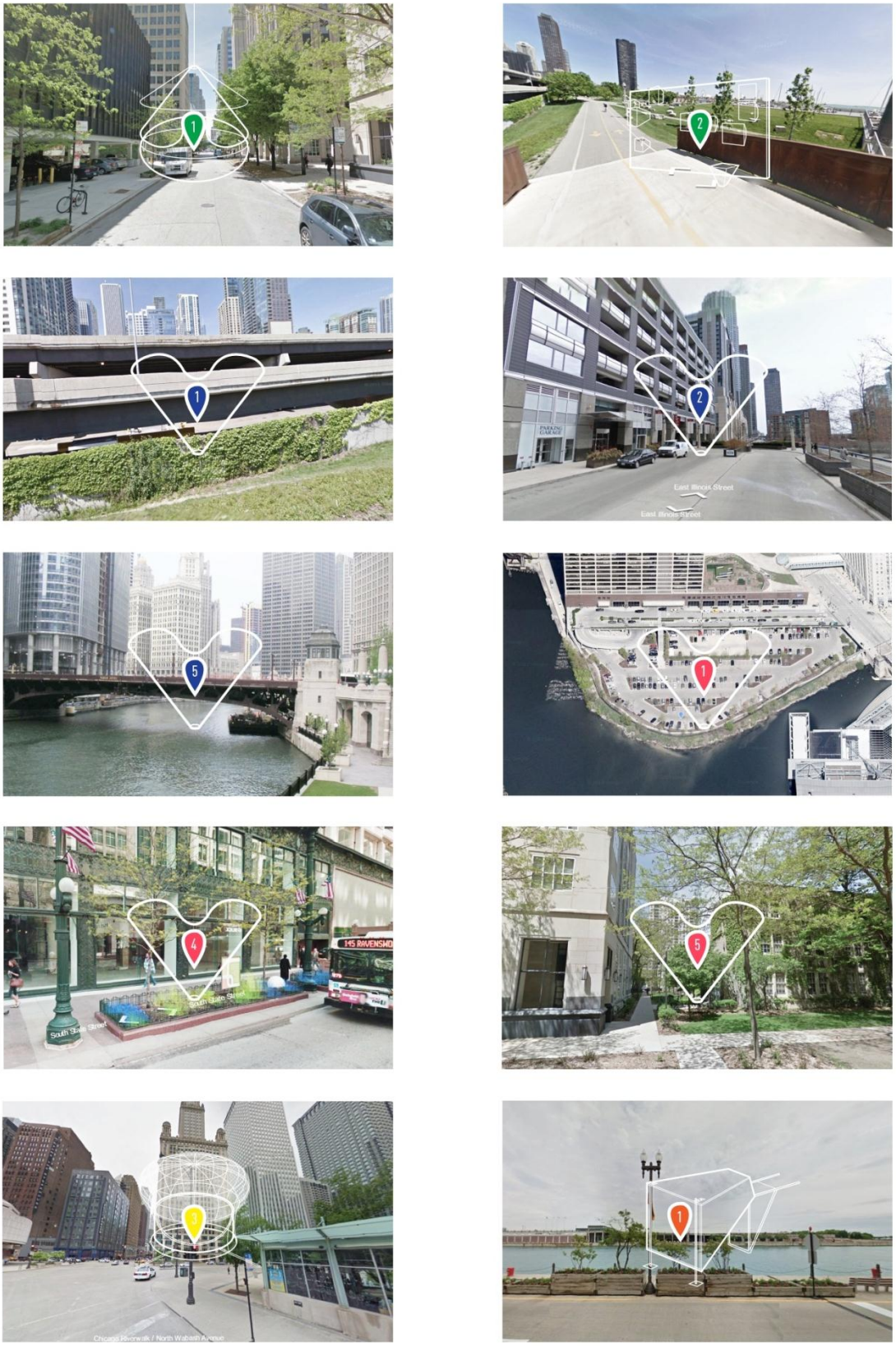

Figure 7.3: Views of 20 selected sites

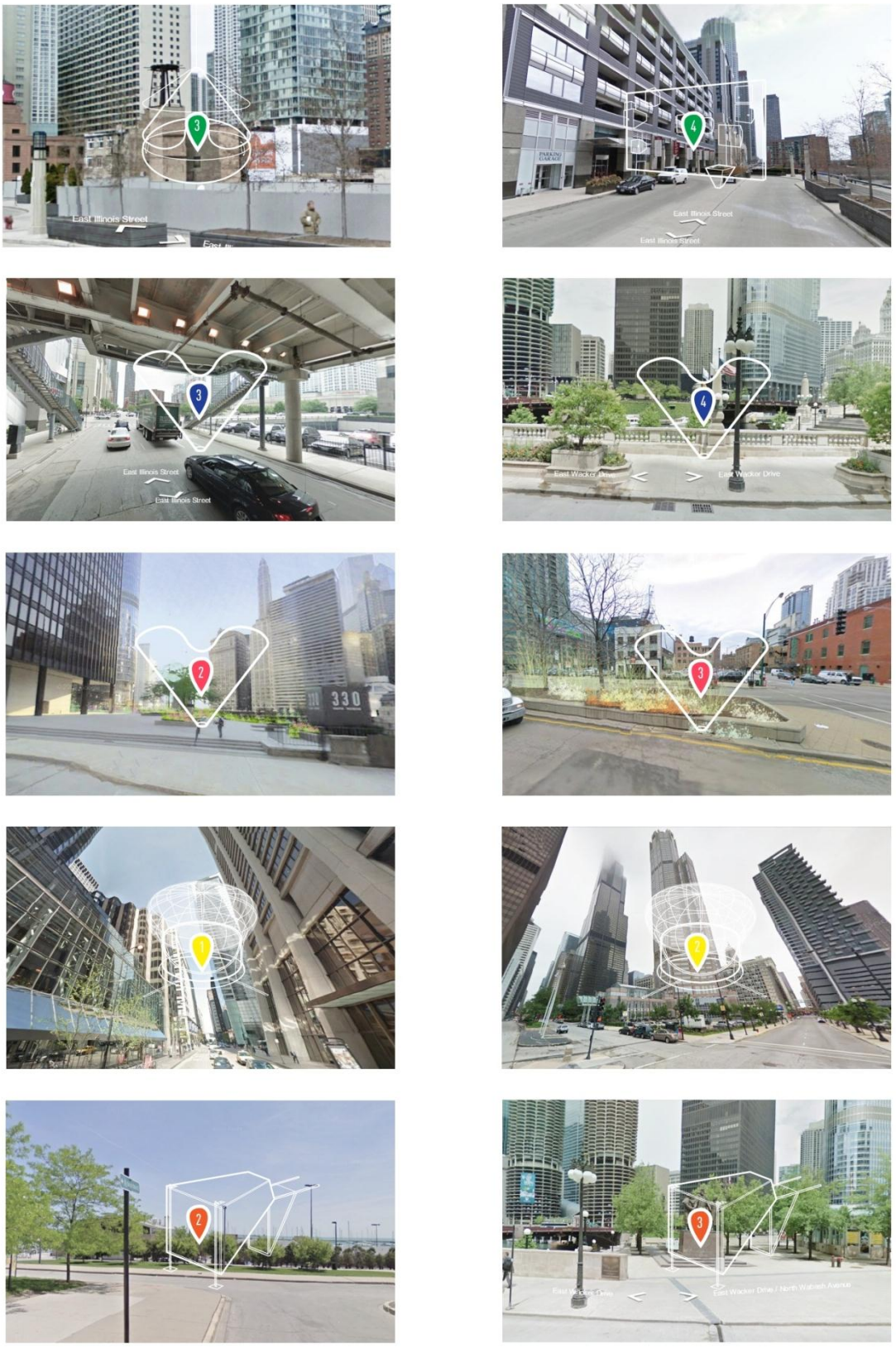

Figure 7.3 continue: Views of 20 selected sites

CHAPTER 8: CONCLUSION

This thesis focuses on exploring the potential of urban interstitial spaces for the creation of bird habitats through a series of ecological studies, analysis of target birds, design prototypes, and mapping. It presents a new perspective on transforming interstitial spaces into habitable places for birds. These spaces could serve as a connected habitat system between traditional green spaces, suggesting that the city and its spaces act as habitat and home to birds. This project aims to attract and welcome certain target species back into an environment that has been dominated by humans, with the aim of forming a symbiotic relationship between the birds and humans, which would be beneficial for the ecological health and well-being of both species. At the same time, these activated interstitial spaces would be expected to increase citizens' awareness of birds and might become a catalyst for people to reassess their opinions about urban wildlife. The proposals also exist at the intersection of domesticity and the public realm, suggesting that birds inhabit the city, and take on meaningful roles in the stories and lives that define urban living.

The study analyzes the habitat preferences of five target species and suggests specific nesting prototypes to be built in downtown Chicago. The work of testing and evaluating the prototypes has not yet been done. Because urban ecological systems are characterized by complex interactions among social, economic, institutional, and

environmental variables, it is hard to determine whether the interstitial habitat proposed here would provide a positive effect on the urban environment. Furthermore, some problems might occur during the design application, such as infectious disease that may spread by certain birds, ecological imbalance issues caused by the overpopulation of the particular species, and the anxiety of humans. These details remain to be discussed and developed further, yet the thesis establishes a set of questions that challenge assumptions about how the city is built and used, and how birds may dwell among humans.

Despite these challenges, the design approach of this study can serve as a possible model for other cities with urban fabric and bird population similar to those of Chicago. The study could also encourage valuable discussions that would explore innovative ways to inspire new connections between urban wildlife and the public.

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